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THE VISIBILITY OF THE PULMONARY VESSELS (ANGIOPNEUMOGRAPHY)¹

by

Lopo de Carvalho and Egas Moniz

Professors of the Lisbon Faculty of Medicine

(Tabulæ XLIX—LVIII)

Introduction

After the visibility of the cerebral arteries (EGAS MONIZ and ALMEIDA LIMA) and the large abdominal vessels (REINALDO SANTOS, LAMAS and CALDAS) has been obtained, there lacked only the radiography of the arterial system of the lung to complete the radiological examination of the entire circulation of the organism.

The problem of pulmonary visibility might be presumed as being of easy solution, seeing that the methods of cerebral arteriography and of abdominal aortography are, after all, based simply on the introduction of an opaque substance into the blood-stream.

It does not always happen, however, that what in theory is presumed as being of easy realization, can be carried out in practice without appreciable difficulty. Rare, indeed, is the research which, during the first attempts, does not oblige the investigator to interrupt temporarily some of his experiments, forcing him to tread new paths and to pursue a different direction to that initially anticipated.

This was the case with angiopneumography, for, if the radiography of the arteries of the systemic circulation was, in theory, easy to obtain by the injection of a solution opaque to X-rays, either into certain vascular branches (head and limbs) or directly into the aorta (abdomen and pelvis) the same did not occur with regard to the problem of obtaining visibility of the vascularisation of the lung.

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The introduction into the pulmonary artery of the substance opaque to X-rays, by puncture of that vessel, was indeed a task of no easy execution. On the other hand, the injection of the substance into the general venous system, considering the great quantity of blood in movement, would lower its concentration to such a minute percentage as would certainly render it invisible. Lastly as the lung is a highly vascularised organ, with an extensive capillary network, it would not be surprising if any opaque liquid introduced into the pulmonary circulation should give rise, not to an assemblage of visible arterial vessels, well contrasted but to a simple shadow, uniformly diffused and without detail.

The problem, therefore, was complex. Before seeking to solve it in such a manner as to avoid any operation that would render it impractical and of difficult or dangerous application, it was necessary, as a preliminary step, to verify it, as a matter of fact, the introduction of an opaque substance into the right ventricle and its consecutive dilution in the vascular system of the lung, would permit the easy differentiation of the blood vessels.

Experimental work

The first experiments realized in October 1930, consisted then in radiographing some laboratory animals, mostly rabbits, just as a few c. c. of a 40 % solution of sodium iodide were injected into the right ventricle, through the chest wall.

The results obtained were highly successful. The vascular system of the lung was rendered visible, especially in the vessels of larger caliber. The possibility of obtaining the drawing of the arterial tree was thus demonstrated experimentally, and in consequence, any preliminary attempts to obtain angiopneumography in the human body were justified.

The problem, however, still presented great difficulties, not only as regards the choice of the liquids, opaque to X-rays, that should be inoffensive to the lung, but also considering the great quantity of blood kept within the venous circulation, which would certainly reduce to a low percentage the concentration of the substance injected.

Our choice of an opaque liquid fell naturally on the solution iodide, already studied by Prof. EGAS MONIZ from the triple point of view of its toxic properties, irritating action on the tissues and opacity to X-rays.

As regards the rapid decrease of the concentration of the product, we were of opinion that this could possibly be attenuated by introducing rapidly the chosen solution into the median basilic and diminishing simultaneously the afflux of blood to the right heart, either by applying tourniquets to the free limbs or by pressure applied to the internal jugulars, in the neck, and to the inferior vena cava, through the wall of the abdomen.

Our first attempt was realized on the above lines, 10 c. c. of a 25 % solution of sodium iodide having been injected into one of the veins of the arm. In the radiograph obtained, the opaque liquid was visible as far as the subclavian vein but, beyond that, the opacity completely disappeared.

In view of this failure, we repeated the experiment, giving simultaneously two injections, in the right and left median basilics, of a 30 % solution of sodium iodide, this being the maximum of concentration compatible with painless injection in the veins of the arm. The radiograph of the thorax still revealed nothing except visibility of the product up to the two subclavians, where it ceased abruptly.

This new failure demonstrated evidently that, in order to obtain angiopneumography, it would be necessary, not only to increase the concentration of the opaque substance, but also to administer the injection as near as possible to the superior vena cava.

From this arose naturally the idea of utilising for that purpose the external jugular vein. It was necessary, however, before pursuing this course, to make further experiments on laboratory animals, in order to avoid any disagreeable incident which might occur if, without previous study, the new method were employed on a human being. We did not know indeed, whether an intravenous injection of sodium iodide in the external jugular would be well tolerated and whether the human organism would support, in the venous system of the neck, solutions of greater concentration than 30 %.

The animal utilized for the new essays was the rabbit. The jugular vein having been exposed, solutions of sodium iodide, of increasing strength, were injected into it, whilst at the same time radiographs of the animal were taken. We obtained in this way a series of angiopneumographs, whose differentiation increased according to the greater rapidity with which the injections were given and to the higher concentration of the product. Fig. 1 completely illustrates this fact.

We verified at the same time that the lung of the rabbit supported without any harm the action of the sodium iodide, even in high doses, for we attained concentrations of 100 %. These experiments did not authorize us, however, to administer to human beings injections of such high percentages, and we thought it safer to employ progressive doses.

This new course having been decided on, after being based on numerous laboratory experiments, we made our first essays on the human organism with 35, 40, 45 and 50 % solutions of sodium iodide. On the contrary to what we confidently expected, nothing was revealed by the films obtained — the arterial system of the lung was not delineated, the jugular vein alone being apparent. In some of the radiographs obtained, we encountered, however, an aspect which was not easy to ex-

plain in view of the results obtained from our experiments on the rabbit. In every case in which the injection was administered energetically the product injected did not travel in the direction of the blood-stream alone; part of it refluxed, as if the caliber of the vessel was insufficient to give a free passage to the amount injected. (Fig. 2.) This awoke our desire to administer the injection as near as possible to the brachio-cephalic trunk. After the experiment was made, we recognized that



Fig. 2.

the opaque liquid still maintained the same reluctance in following the path which should lead it to the superior vena cava.

It was at this juncture that we thought of utilizing the large vessels of the neck. Numerous experiments were made on corpses, and we were able to verify that it was easy to attain, not only the brachio-cephalic trunk, but the superior vena cava itself. On introducing a needle between the sternal and clavicular portions of the left sterno-cleido-mastoid and directing it towards the posterior face of the sternum, its point penetrates with certainty one of the vessels referred to.

The facility with which this puncture was made in a corpse encouraged us to try an injection into the brachio-cephalic trunk or the superior vena cava itself, of a human being. Various attempts were made. On numerous occasions we introduced the needle in the manner above described, but only on extremely rare opportunities were we able to

obtain a few drops of blood, although we employed a high degree of suction, inclusively that obtained by means of an electrical suction pump. This fact, the explanation of which we could not arrive at with certainty inasmuch as in the case of corpses, a puncture made in a similar manner was rewarded by an immediate yield of blood, restrained our intention to introduce the opaque substance into the punctured vessels, in view of the fact, already verified in our preliminary experiments, that the injection given outside any vein might have grave consequences.

It was therefore indispensable, the more so as important vascular trunks situated in delicate regions were involved, to be sure that the point of the needle was inside the vein. Only the easy obtainment of a few drops of blood, as in the case of any ordinary venous puncture, could guarantee us as to the situation of the needle, and our uncertainty on the matter was sufficient to make us abandon this way.

Nevertheless, we made the attempt on one occasion, convinced, in the case of one of our patients, that we had attained the subclavian vein. We injected rapidly and energetically 16 c.c., approximately, of a 60 % solution of sodium iodide. During the injection and at the moment we were about to press the bulb of the X-ray apparatus, the patient complained of a violent pain. We immediately suspended the impulsion of the piston of the syringe and simultaneously took a radiograph. This at first sight showed an accentuated distension of the vessel together with extravasation of the liquid. Examined with attention, it revealed further that the opaque solution had travelled very little with the current towards the superior vena cava, having refluxed, rather, in the opposite direction towards the external portion of the subclavian.

The series of experiments hitherto realized served, therefore, to demonstrate that the blood stream in the vessels of the neck did not obey the same principles as those upon which is based the circulation in the venous trunks of other parts of the organism, such as, for example, those of the limbs, so frequently punctured for therapeutical purposes. The difficulty in the suction of blood from the cervical venous trunks could only be ascribed to the accentuated negative pressure habitually existant in those vessels. Indeed, in later laboratory experiments we had the opportunity to verify that in the dog, for instance, the vena cava having been exposed, the puncture of its upper extremity did not permit the easy extraction of any quantity of blood whilst the animal's life continued and its cardiac systoles were rhythmically marked. The piston of the syringe was, however, strongly impelled by blood entering the barrel as soon as a cardiac syncope supervened, bringing with it complete cessation of the rhythm. The mass of blood, affluxing from the whole peripheral venous system towards the right auricle, and encoun-

tering the cardiac cavities flooded, accumulated in the vessels themselves and for this reason the negative pressure disappeared, giving way to an appreciable internal tension. It is easy for anyone wishing to do so, to perform this simple experiment, which renders so clear the interpretation of the facts stated above.

There still remained to explain, however, the difficulty encountered by the opaque solution in following the direction of the blood-stream. Was it due to the low velocity of the blood in the vessels in question? But, in that case, how should be interpreted the experiments previously made on rabbits, in which the injection given in the jugular vein penetrated immediately the right auricle, from this to the ventricle and thence to the vascular system of the lung, the viscosity of which was rendered so intense? Was perchance the circulation in the rabbit different to that in man; its velocity in the former being greater than in the latter, contrarily to what might be expected? It would be more natural, indeed, that the tributary circulation of the head in man should be more rapid and intense than in the rabbit, but, however, it seemed that this was not the case.

This series of conjectures, derived from the experiments in course, constituted therefore, new «incognitae», on the determining of which undoubtedly depended the pursuit of the experiments already begun, this independently of the interest which the matter in itself might possess in the field of comparative physiology.

The explanation, however, was simple, being that in man, the external jugular has nothing to do with the cerebral circulation, but merely collects the blood from the cranial walls. It is the internal jugular which takes charge of all the encephalic venous system, this being the reason of its marked development. In the lower animals, as in the case of rabbits, for instance, the same does not occur, for in these the internal jugular is rudimentary and has no connexion whatever with the venous blood of the encephalon, the return or the cerebral blood-stream being by way of the external jugular, which gains on account of its function, a pronounced development. Now, as the brain is a section of the organism which requires, for its regular function, the guarantee of an easy return circulation, in order to avoid any stagnation, be it so insignificant, in its intimate cellular elements, it is comprehensible that the bloodstream of the internal jugular must be always respected, even though other neighbouring circulations discharging into the brachio-cephalic trunk be prejudiced.

The blood conveyed by the internal jugular must not encounter, therefore, to avoid the harm of grave derangement of the cerebral functions, the least obstacle to its discharge into the vena cava, whilst in the case of all the other affluents of that vessel, the discharge of blood

may be retarded or retained without prejudicing the cellular activity of the tissues from which it comes.

It is comprehensible therefore, that when we endeavoured to inject the solution into the external jugular or the subclavian, a great part of the liquid forced in by the pressure applied should reflux in the opposite direction to the blood-stream. It is also possible that, at the same time, the hydraulics of all these venous drains of the neck are damaged by the entry into the circulation of a liquid possessing a higher density than that of the blood and that this factor contributes, in its turn, to prevent the injection administered by way of the subclavian vein from arriving at the auricular cavity with the required velocity.

Whatever may be the precise cause of the phenomenon, which in part is explained by the anatomo-physiology of the cervical vessels, the fact remains that it is impossible to obtain visibility of the pulmonary vessels in man by the introduction of an opaque liquid into the superficial venous system of the neck, and if in the case of rabbits, dogs and other laboratory animals an angiopneumograph was easily obtained by the injection of the sodium iodide solution into the jugular vein, it was only because this was the duct which led the blood more directly to the heart, seeing that it corresponds to the internal jugular in a human being.

To obtain, therefore, visibility of the pulmonary circulation in man, it would be necessary to introduce the opaque substance into this latter vessel. This would only be practicable by a surgical intervention, not only unjustifiable but also leading the angiopneumographical test to lose all interest from a clinical point of view.

It was then that the idea came to us of introducing a catheter by way of the superficial veins of the neck (anterior jugular or external jugular) as far as the superior vena cava, and injecting through it the solution of sodium iodide in proximity to the right auricular cavity, into the plenary sanguineous mass. The problem of visibility of the pulmonary vessels might perhaps in this way be easily solved.

We did not know, however, if the human organism would be indifferent to the sounding of its venous vessels. Alterations of the endothelium, with grave consequences, or other reflex phenomena might appear, their starting point being the sensitive innervation of the lining. It was therefore necessary to return to our experiments on laboratory animals.

This we proceeded to do, utilizing successively rabbits, dogs and finally monkeys, as material for our experiments. The jugular vein having been exposed, we introduced the sound, either through a small aperture in its wall or through the tube of a small trocar with which we had previously punctured the vessel, this being maintained turgid by

a slight pressure applied to its lower extremity. We perceived that the sound was beared well by the animal. No reflex was produced and the sound was introduced with extreme facility, without giving rise to any spasm. It reached the auricle rapidly and even passed it, travelling along the inferior vena cava without any manipulation being required. The auricular sounding, following the path of the femoral, the iliac and the inferior vena cava itself, was equally well supported, no incident supervening. Some angiopneumographs taken of animals according to this technique demonstrated the possibility of obtaining a greater richness of detail.

Fig. 3 shows a film obtained with an intra-auricular injection through the catheter. The strong pressure exerted on the piston of the syringe obliged the liquid to pass beyond the cavity and to overcome so completely the current of blood coming from below as to render visible the venous system of the liver. Interesting, also, is Fig. 4, in which the sound, introduced along the inferior vena cava, through the auricle, permitted visibility of the hepatic and the splenic vessels to be obtained, although the pulmonary circulation was not evident.

This experiment permitted us to foresee the hypothesis of the venous angiography of some sections of the inferior vena cava being realizable, but nevertheless we considered this new field of research as being extremely delicate, inasmuch as all the rabbits in which it was possible to obtain visibility of the vessels referred to, by means of an injection given with violence in the opposite direction to the blood-current, manifested immediately signs of suffering, followed in a few moments by death.

The angiopneumographs of a dog (Fig. 5) and of a monkey (Fig. 6) obtained by auricular soundings, either through the jugulars or the inferior vena cava, bore testimony to the fact that the test was absolutely innoxious to organisms which occupy a higher place in the zoological scale than the rabbit, on which our experiments were usually made.

Angiopneumography in the man

The favourable results obtained in this series of experimental essays encouraged us to attempt the sounding of the veins of the neck on man, in order to enable us to inject the sodium iodide either into the auricle itself or into the superior vena cava, or at least into one of the large cervical vessels, in which a retarding of the flow of blood does not affect the cerebral circulation — the internal extremity of the cephalic trunk, for instance.

Various attempts were made, a small sound being introduced through a slender trocar with which the external jugular or the anterior jugular had been punctured.

A fresh and insurmountable difficulty, however, was encountered; the progress of the sound, which at first was easy, was stopped after travelling a short distance. An obstacle presented itself, impossible to overcome, for if by applying gentle pressure we endeavoured to force the sound in, it bent but did not travel any farther. On administering the injection at this stage and proceeding simultaneously with the radiographical examination of the thorax, it was found that the progress of the sound was suspended on arriving at the clavicle and that the opaque liquid had spread itself transversely on each side of its point, without following the path of the vena cava. The reason of this is, that the external jugular into which the sound was introduced is nearly always placed obliquely, at an acute internal angle, on the brachio-cephalic trunk, before the junction with the internal jugular. The sound could not therefore travel any farther, as its flexibility was not sufficient to allow of it doubling up on itself.

Access to the vena cava was therefore impossible through this way, and it is also not surprising that the opaque liquid did not follow the path we desired it to, inasmuch as its introduction through the sound corresponded to an injection given in the external part of the brachio-cephalic trunk, which, as we have already seen, invariably causes the partial detention or reflux of the liquid, owing to the continually dominant encephalic circulation.

The problem of visibility of the pulmonary vessels in man continued, consequently, to lack an easy solution.

It was at this stage that we came across an article by FORSSMANN, published in the *«Klinische Wochenschrift»* of the 5th. November, 1929, in which the author states that he has introduced, both into himself and also into some of his patients, a catheter opaque to X-rays, by way of the veins of the arm, as far as the right auricle. In view of this report and also as we had already certified ourselves regarding the innocuousness of the sounding of the cervical vessels, we decided to attempt this new way.

In the first place we made some experiments in auricular sounding, introducing the sound into the cephalic or median-basilic and simultaneously injecting a few cubic centimetres of physiological salt in order to facilitate its progress. No trouble whatever was suffered by the patients.

In some cases the experiment was performed easily, but in others some difficulties were encountered, the sound sometimes stopping in the brachio-cephalic trunk at the point of junction of the external jugular, following the channel of this vein in an upward direction when we forced it. By withdrawing it slightly and giving it a new impulse, pres-

sing it at the same time against the vertex of the axilla, in the greater number of cases, to make it take the road to the vena cava.

This obstacle having been surmounted, the passage to the auricle was always made without the least difficulty. By impelling the sound a little more, it even passed the cavity referred to, entering the inferior vena cava and passing by the right ventricle, on the contrary to what might have been expected. This fact, already noted by FORSSMANN, was caused, on the one hand, by the obstacle which the auriculo-ventricular valves in a living being naturally oppose to the entry of a sound and on the other by the insufficiency of the eustachian valve, which permitted it to enter easily the inferior cava, placed, as this is, in the path it followed.

The catheterisation of the auricle having thus been realized, it was only necessary to inject the sodium iodide solution into the cavity referred to, in order to obtain in all probability the vascular design of the lung.

We were afraid, nevertheless, that the introduction of the opaque substance at a high percentage might give rise to some lesion of the auriculo-ventricular valves, and this apprehension led us naturally to make some further preliminary experiments before proceeding with the work already commenced.

We sought in the first place to find the minimum limit of concentration necessary to obtain visibility of the vessels. To blood contained in a series of test tubes we added sufficient quantities of sodium solution in order to obtain concentrations of 0.5, 1, 2, 3 and 4 grammes per cent. We then took radiographs of the tubes and were able to verify that with 2 % solutions a slight opacity to X-rays was perceptible. — Fig. 7. Now, as the right ventricle of adult man has a capacity of 170 c. c. and as at each systole, according to HENDERSON, MEAKINS, DAVIS, DAUTREBANDE and others, there is a discharge of 100 c. c., it follows that at each diastole 2 grammes at least of sodium iodide must enter the cavity in order that visibility may be obtained. The concentration of the liquid to be injected depended therefore on the rate of flow through the sound.

In our first experiments we employed ureteral sounds opaque to X-rays and from which we had removed the terminal olives. These sounds permitted a maximum rate of flow of 2 c. c. of physiological salt per second, even when the piston of the syringe adapted to them was energetically impelled, this by virtue of the enormous resistance encountered by the liquid on its long journey. It was therefore necessary that the concentration of the sodium iodide solution should be at least of 100 % in order to obtain visibility of the vascular system of the lung. In our calculations there was still to be considered the fact that the viscosity of the sodium iodide solution is greater than that of physio-

logical salt and, in consequence, its rate of flow through the sound would evidently be less. This circumstance made it necessary, therefore, to employ it in a higher degree of concentration, as only in this way would the blood, on attaining the pulmonary vessels, convey the percentage required to assure their visibility.

The solutions of sodium iodide were, however, instable at over 120 %; beyond this concentration iodine was liberated, rendering the solution inapplicable because of the danger resulting from its introduction into the vessels. Only one recourse remained: that of increasing the rate of flow through the catheter, and this was the procedure adopted. We commissioned Mr. GENTILE, a Paris firm, to manufacture special sounds in accordance with indications we furnished them. The diameter of these sounds, nevertheless, could not go beyond a certain limit, and this obliged us to employ 120 % solutions of sodium iodide in order to obtain good angiopneumographs.

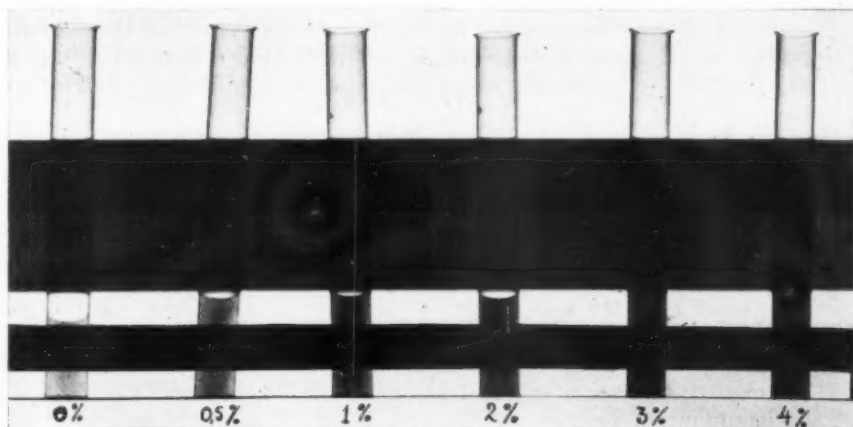


Fig. 7.

It was to be feared, however, that such solutions would have an irritant action, not only on the walls of the auricle, but also on the auriculo-ventricular valves, unless, when mingled with the bloodstream, they should become immediately diluted and their concentration drop rapidly to 2 or 3 %.

A new experiment was therefore necessary, before proceeding any further, in order to determine the rapidity with which concentrated solutions of sodium iodide were diluted in the blood. For this effect, two Petri plates, both containing a certain quantity of blood, were placed side by side on an X-ray film and upon one of them were poured a

few cubic centimetres of an opaque substance at a high concentration, the bulb of the apparatus being immediately pressed.

The result was encouraging, as no limit of opacity was shown on the plate in which the mixture had been made and which presented an equal tonality over all its surface. Still unconvinced by this experiment, we radiographed another Petri plate also containing blood, at the precise instant in which we injected into it, with a syringe, a certain quantity of the iodide solution. Fig. 4 shows clearly that the dilution is immediate.

In presence of the result of these experiments we decided finally to realize the first intra-auricular injection of a highly concentrated solution of sodium iodide in order to obtain angiopneumography in man.

Commencing prudently, the first injections were given with a 40 % solution, as we hoped that with this percentage we might obtain some aspects of the vascular system of the lung. As is of common knowledge, the pulmonary design habitually apparent in the radiograph of a living being does not exist in a corpse, for the reason that it is not the vessels themselves which produce that image, but the blood contained in them in the fraction of a second which constitutes the duration of the exposure.

A small quantity of the opaque substance, even of a minute percentage, when disseminated in the arterial system might therefore make the pulmonary design stand out. It is comprehensible, therefore, that at the beginning, the solutions employed were of lower concentration than those which, by the process of simple ratiocination above described, we had considered necessary.

The result however was negative, for only by exercising our imagination could we discern a slight tracing of the vessels at the root of the lungs.

We then passed on to concentrations of 60, 80, 100 and 120 % and at the beginning of February 1931, with an 80 % solution, we obtained our first angiopneumograph. After so many difficulties, only overcome by an unwavering persistence we had attained the end desired—visibility of the pulmonary vessels.

A few days afterwards, we repeated the radiographical examination of the same patient, this time with a 120 % solution. The richness of detail increased with higher concentration, which since then we have always employed, in view of its absolute innocuousness.

Having concluded these remarks, general in character, which contain the history of angiopneumography, and the perusal of which we consider as being profitable to all who wish to enter the field of clinical research, owing to the criterion — that of preceding by a series of laboratory tests, in order to guarantee its innocuousness, any experiment

to be made on the human organism which from the beginning guided the course of our present task, we will now proceed to describe the technique actually employed, the causes of failure, the incidents observed during the tests and, finally, the interpretation of a few radiographic films.

The technique of angiopneumography

Under this heading we shall refer not only to the operation in itself, in part already explained by the foregoing remarks, but also to the material required for its realization.

The contrasting substances: We fixed upon the 120 % sodium iodide solution, after some experiments performed on animals with other substances of a high atomic weight, one of them being calcium iodide. The salt employed must be pure; the solutions must be recently prepared and duly sterilized.

If the ampoules in which the solution is kept become yellow, even if only slightly so, the product must not be utilized, as the coloration denotes the existence of free iodine, which cannot be administered without danger.

Catheters: The sounds manufactured specially by Mr. GENTILE in accordance with our indications, are identical to the Nos. 12 and 14 ureteral sounds, opaque to X-rays, differing from them only by possessing three orifices at their extremity, one of these orifices being terminal and the other two lateral, in proximity to the first. The trocars were also made to a special pattern destined for venous punctures, which are not always easy to make, and it was absolutely necessary for them to possess some device which would enable us to know immediately when their point was inside the vein. A simple needle, adapted to the tube of a small trocar, solved the problem; Fig. 8 illustrates this.

Preparation of the patient: The test should be made on an empty stomach, with the patient seating. His arm being placed horizontally and the skin having been disinfected with tincture of iodine, the forearm is bound with a sterilized compress and a tourniquet applied to the middle part of the arm, as if a simple venous puncture were about to be made. The region of the median basilic is anaesthetized with a small

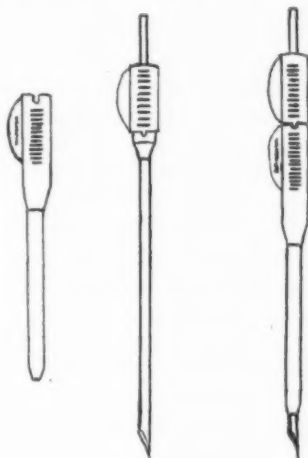


Fig. 8.

quantity of novocain-adrenalin, in order to avoid the patient feeling the slightest pain, which the introduction of the trocar, owing to its relative thickness, would naturally cause and which is always prejudicial to the carrying out of the test.

Introduction of the sound: This can be performed through the skin, when the size of the vein permits the trocar to be introduced, or through a small incision (phlebotomy) easily and harmlessly made, if the vessel is too small to be punctured. The sound, previously sterilized and bathed in a sterile solution of sodium citrate at 10 %, is then slowly introduced, while at the same time, by means of a syringe adapted to its other end, small quantities of physiological salt are injected, in order to facilitate its progress and to impede the formation of any clot of blood in its path.

The progress of the sound is then observed by means of its image on the screen of the X-ray apparatus. Rarely does it attain the superior vena cava without encountering some obstacle. As a general rule this happens when it reaches the inner portion of the clavicle. There, if it has not already insinuated itself into the external jugular, in the direction of the cranium, it stops. By withdrawing it slightly, raising the arm, pressing it from the outside against the vertex of the axilla and giving it a new impulse, it then follows easily the desired path up to the lower extremity of the vena cava or as far as the auricular cavity itself. It is more easily introduced through left than through the right arm, owing to the anatomical disposition of the vessels of the neck, both as regards the lesser curvature of the left brachio-cephalic trunk and the disposition of certain venous branches which, on the right, are lodged exactly at the point where the sound has to be deviated in order to proceed in the direction of the vena cava.

The injection: After the sound has been introduced, the X-ray apparatus is made ready, the film being placed against the anterior surface of the patient's thorax. The syringe with which the physiological salt was being injected is substituted by another, containing the sodium iodide solution, at 120 %. The patient is told to inhale deeply and to remain perfectly still, and simultaneously, the opaque solution is rapidly injected, the bulb of the apparatus being pressed at the moment when 6 to 8 c.c. of the solution have been injected.

After the radiograph has been taken, the syringe containing physiological salt is again applied to the extremity of the sound, a little being injected in order to expel the remainder of sodium iodide contained in the sound, that is now gently withdrawn. The site of the puncture is then bandaged, a small metal clip being applied, if an incision of the vein has been necessary.

Causes of failure

Angiopneumography is not always practicable. Various causes may render it irrealizable or imperfect, and among these should be noted the obstacle which sometimes impede the progress of the sound. This, after entering with relative facility as far as the internal extremity of the clavicle, refuses to proceed further. By manœuvring it in the manner above described, the resistance encountered can, as a general rule, be successfully overcome, but on other occasions this is impossible. In a few rare cases we even found that when the sound was withdrawn a little in order to endeavour to introduce it again, the obstacle which was impeding its progress dislocated itself simultaneously with the point of the sound; the path of the vein, having been abandoned, could not be found again, as if a spasm had been produced and had progressively displaced itself in a direction opposite to that of the blood-stream.

Although only in exceptional cases, we met with certain anomalies of the veins of the arm which led the sound in a different direction, rendering impossible its further progress, even with the aid of a slight pressure exerted against the obstacle encountered. In one case we had the impression that the basilic vein had perforated the aponeurosis, to disappear perhaps into one of the deep humeral veins. The sound, therefore, on crossing the aponeurosis would, in order to attain the deep venous system, have to bend at its head, which would not be easy, owing to its insufficient flexibility.

Imperfections in angiopneumographs are due essentially to three causes. a) The small inter-auricular rate of flow of the opaque substance is, as a general rule, the cause most frequently observed, for its concentration in the blood may not attain 2 per cent., which, as we have seen, is the lowest limit at which visibility can be obtained.

b) A long interval between the beginning of the injection and the exposure of the plate may also constitute another cause of imperfection, by giving the product time to invade the capillary network and to enter into the return circulation. In these circumstances of course the film presents little contrast, being of a grayish shade, weak, and the vascular shadows badly delimited, for the reason that their outlines have ceased to be constituted solely by the walls of the arterial vessels, and correspond possibly to the conjugation and superposition of the arteries and small veins of the lung.

c) The third cause is the X-ray apparatus not being of sufficient potency to enable the exposure to be reduced to a few hundredths of a second. We must not forget that the arterial system of the lung does not maintain itself in absolute immobility. Surrounded by flaccid tissues of little density — the pulmonary parenchyma — the progress of

the blood in its extremely numerous vessels gives rise in it, at each systole, to small oscillatory movements capable of producing a flaw in the film.

In its turn, the cardiac rhythm, conditioning alternate movements of contraction and expansion of the myocardium, produces measured and repeated shocks, which prejudice the clearness of the film, and it is for this reason that, when the exposure is made at the moment of diastole, the borders of the heart and of the larger vessels are well delimited, on the contrary to that which is generally observed when the radiographical examination coincides with other phases of cardiac rotation. Now, since the vessels are made visible by an opaque substance injected into them, it is comprehensible that the degree of clearness depends absolutely on the rapidity of exposure. In order, therefore, to obtain good angiopneumographs, an apparatus capable of taking radiographs of the thorax with exposure of a few hundredths of a second, is required.

The action of the angiopneumographic test on the organism

Patients submitted to the angiopneumographic test feel nothing worthy of note. At the most a slight attack of coughing and, at times, a slight headache which soon disappears. Signs of iodism, which were to be expected in consideration of the doses employed were registered in only 3 % of the cases, the symptoms being limited to lachrymation and coryza two or three hours after the test, the duration of these symptoms never being longer than 24 hours.

The iodide, when introduced into the vascular cavity, appeared to us to have no action whatever on tuberculous lesions of the lung, and, as a matter of fact, in 48 cases of pulmonary tuberculosis submitted to the test, we did not verify any signs of aggravation, either local or general, during the evolution of the disease. There was even an increase of weight in all the cases and if, on the day the test was made, a slight difference of 3 or 4 tenths of a degree was to be noted in the thermic curve, this reverted on the following day to its previous position. In the case of some patients who had been for some time in a sub-febrile state, normalization of the temperature was registered. However, any considerations which the examination of these cases might permit us to make would be premature. In due time we shall return to the subject, but for the moment we only desire to point out the absolute innoxiousness of the test, either to normal individuals or to pulmonary tuberculosis patients.



Fig. 1.



Fig. 3.



Fig. 4.



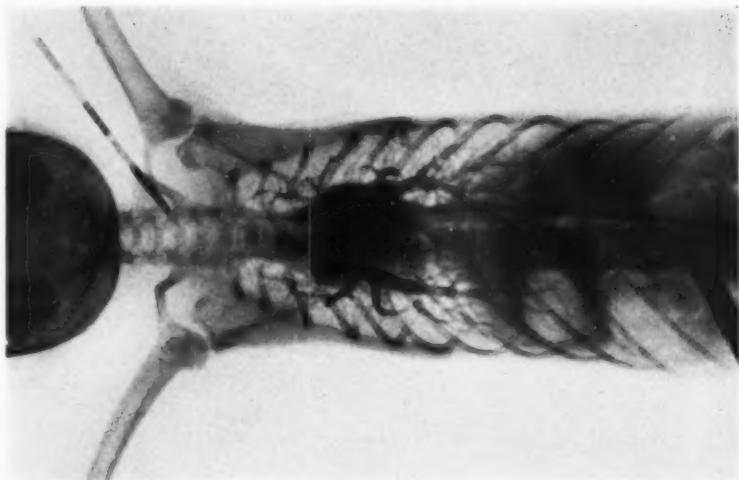


Fig. 6.



Fig. 5.



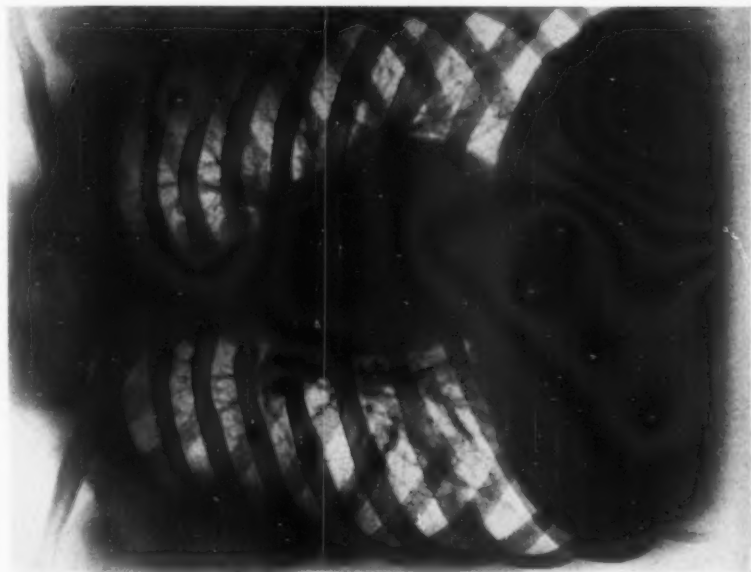


Fig. 10. An angiopneumograph of the same case.

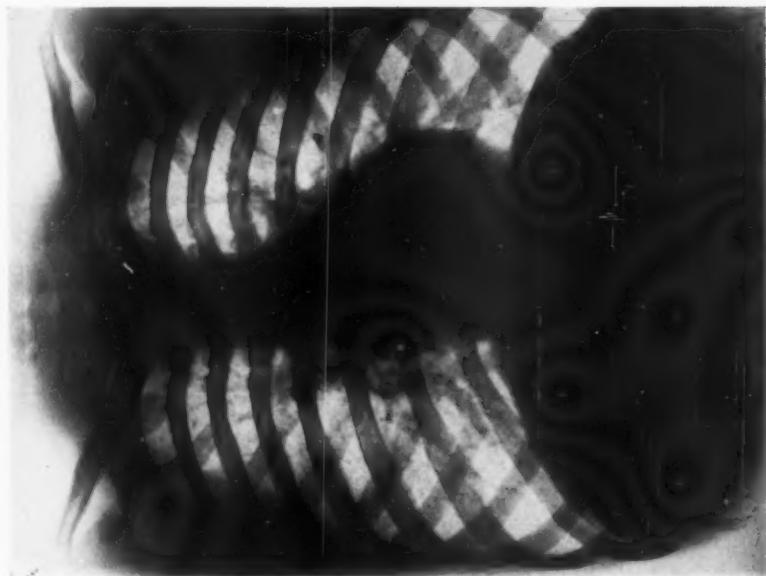


Fig. 9. An ordinary radiograph.



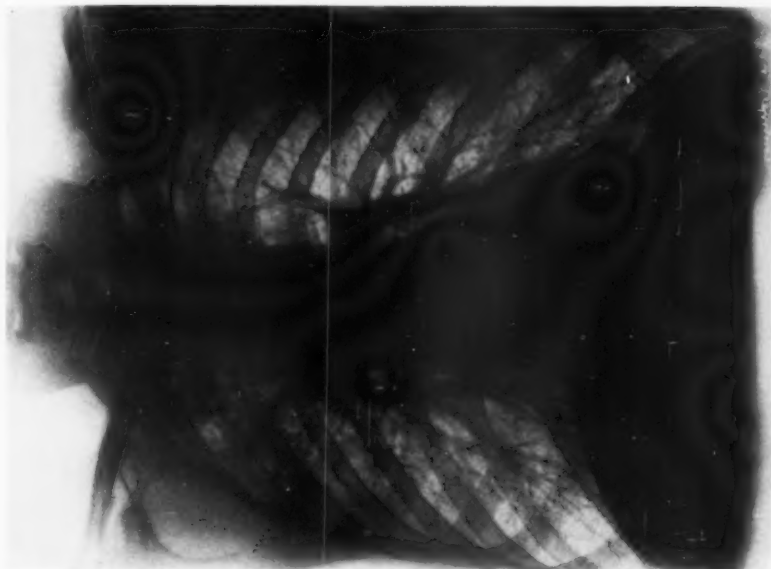


Fig. 12. An angiopneumograph of the same case.

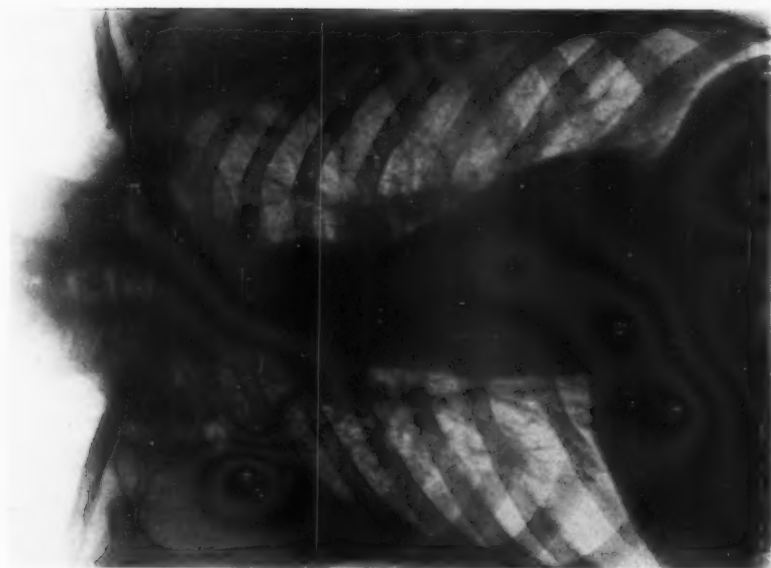


Fig. 11. An ordinary radiograph.



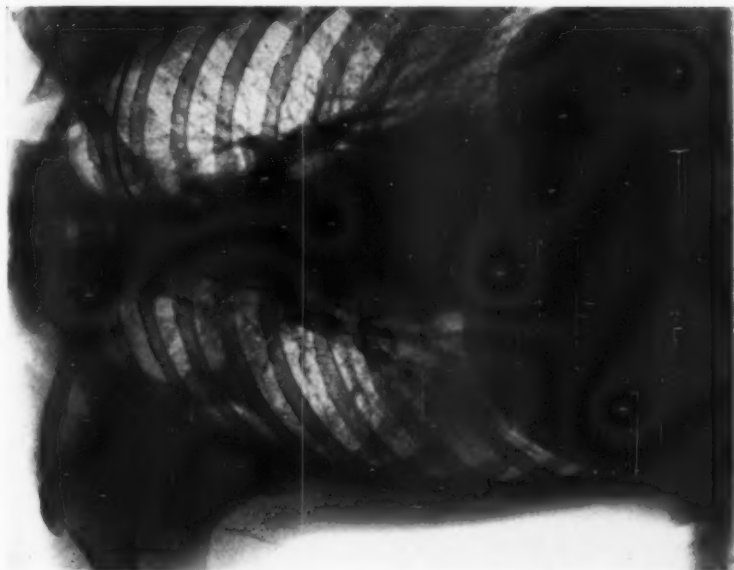


Fig. 14. An angiopneumograph of the same case.

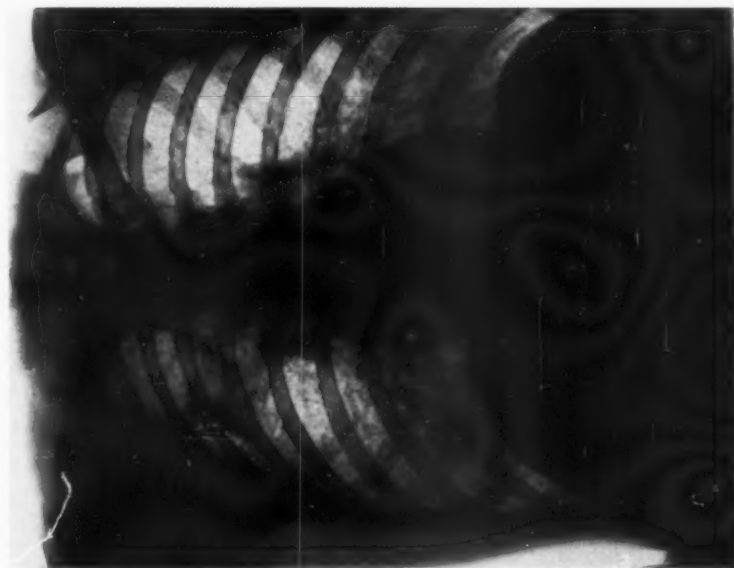


Fig. 13. An ordinary radiograph.



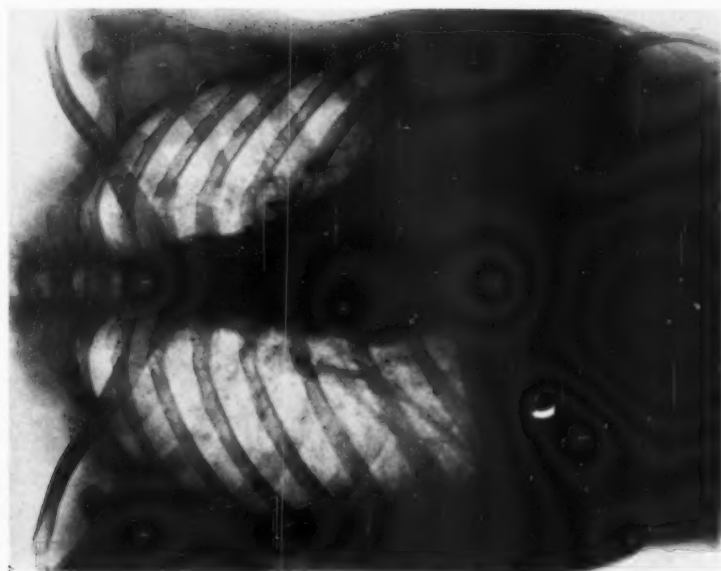


Fig. 15. An ordinary radiograph.

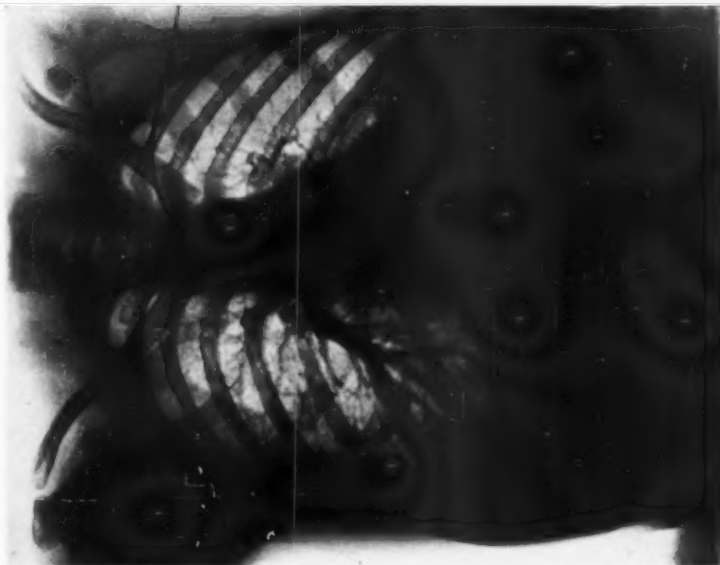


Fig. 16. An angiopneumograph of the same case.

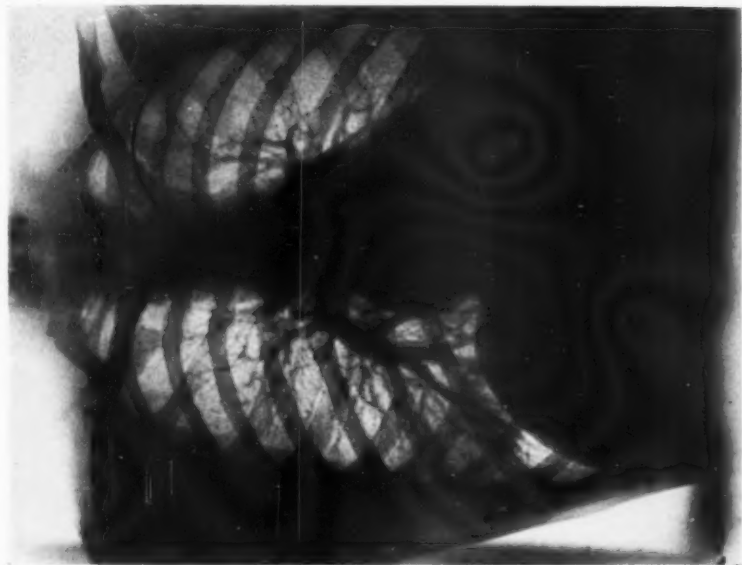


Fig. 18. An angiopneumograph of the same case.

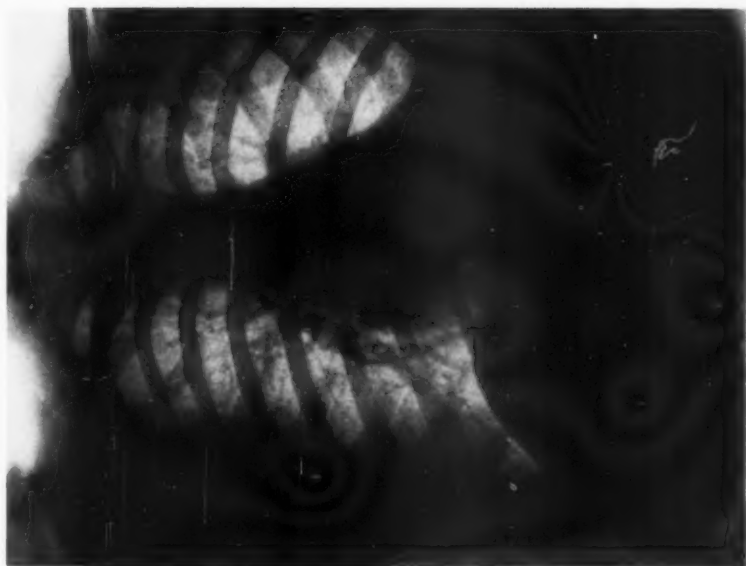


Fig. 17. An ordinary radiograph.



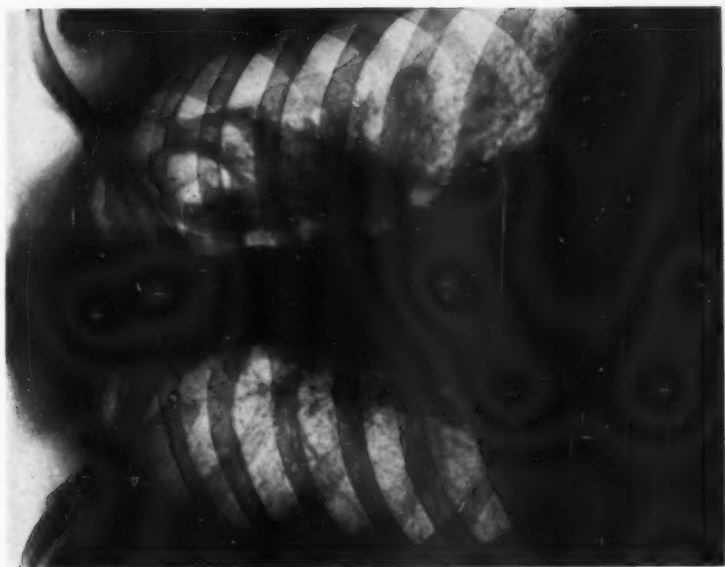


Fig. 19. An ordinary radiograph.

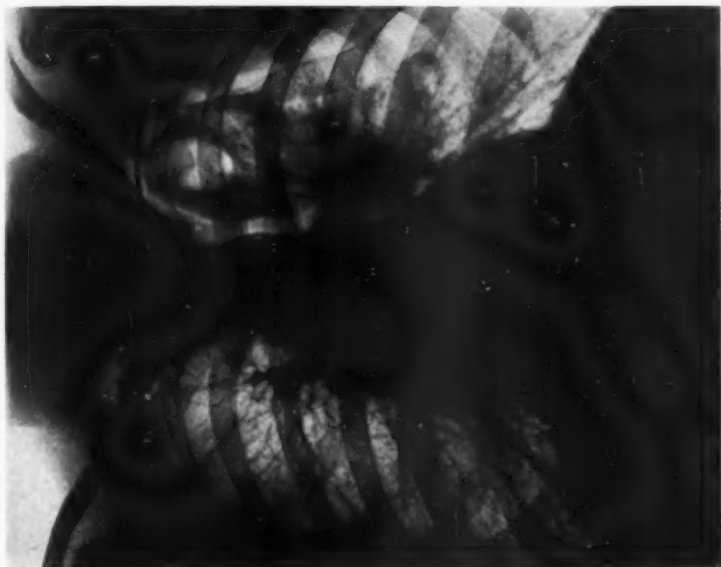


Fig. 20. An angiopneumograph of the same case.



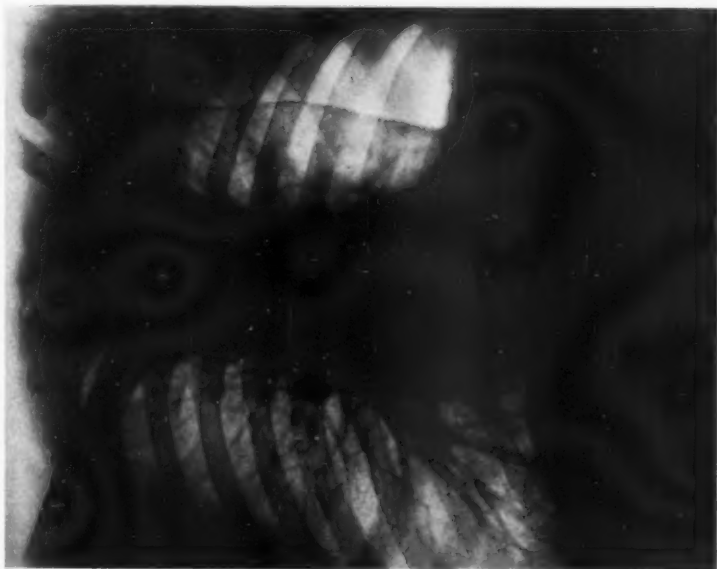


Fig. 22. An angiopneumograph of the same case.



Fig. 21. An ordinary radiograph.



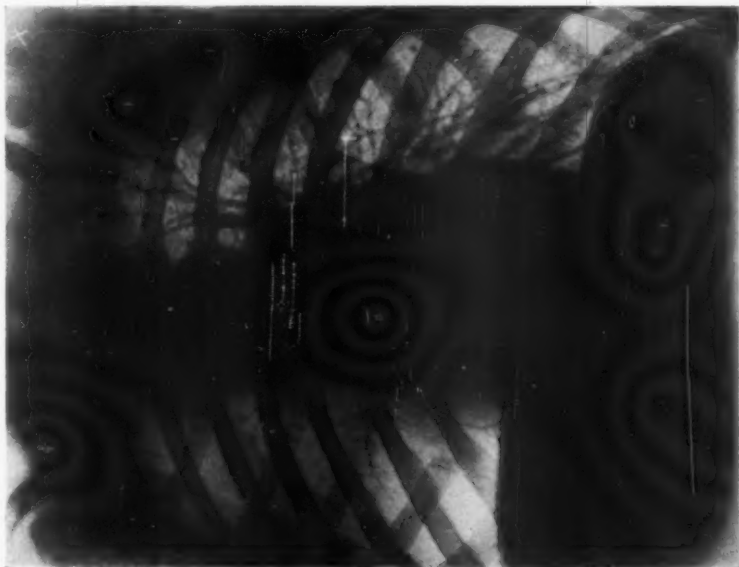


Fig. 24. An angiopneumograph of the same case.

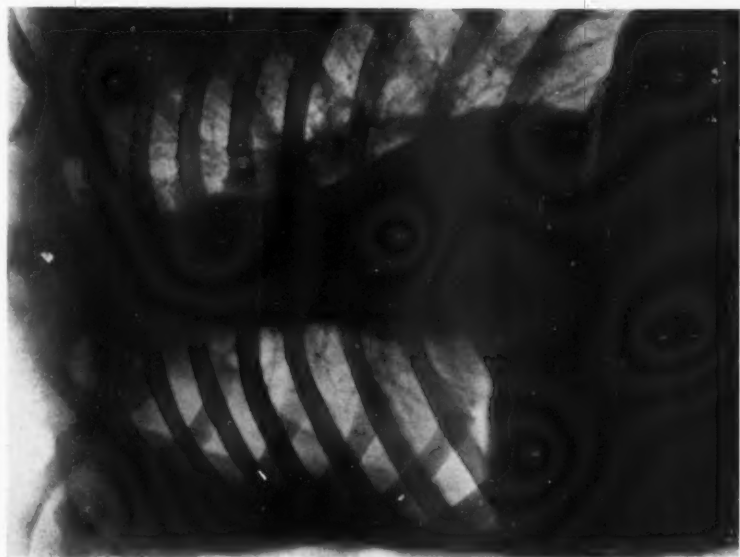


Fig. 23. An ordinary radiograph.



Interpretation of the films

We do not pretend as yet to present a complete study on the interpretation of radiographs of the thorax, our sole desire being, by the publication of a few ordinary radiographic films and the respective angiopneumographs, to call attention to a new process of exploring the respiratory parenchyma. The fact that the condition of the pulmonary vessels can be ascertained, without any harm to the patient would constitute in itself a great advance in radiological semeiotics. The value of the method, however, does not consist in this alone, for, indeed, the indications obtained by the examination of a few films are worthy of note, especially with regard to the pictures of the lung roots, the tuberculous lesions of the lung, and the state of the pulmonary circulation in patients subjected to treatment by artificial pneumothorax.

The method, which is in its outset, will yet without doubt solve many problems of circulatory pathology which up to the present are based only on merely theoretical conceptions and on anatomical examinations.

The therapeutics of pulmonary lesions should also be able to advance along this new road which angiopneumography has opened for the administering of medicine. However, it is needless to insist on the interest of the new method and its future, which the work now in progress, already permits us to outline.

The first fact to be registered from the comparative study of ordinary radiographs and the respective angiopneumographs is that the normal pulmonary design is undoubtedly due to the vessels and not to the bronchi as was supposed at the beginning of the first radiographic examinations.

It is true that, in virtue of the work of ASSMANN, ALBERS-SCHOENBERG and many others, the vascular theory had already become deeply rooted. That theory, however, was based entirely on the study of corpses, and angiopneumography, as realized by us on the living human being, will therefore establish definitely the vascular origin of the radiological design of the lung.

The pulmonary hilus, the radiographical interpretation of which has always been embarrassing, becomes quite easily comprehensible by an angiopneumographic examination. It is true that among the juxtaposed shadows which complicate the picture of the hilus, some are easily interpreted by the simple examination of ordinary films; others however are only capable of being determined by angiopneumography.

By this process the vascular elements can be made to stand out from the adenites and periaadenites (which produce foci of homogeneous

shadows that trouble the picture of the hilus) to which they are juxtaposed. Besides this, the aspects of the branches of the pulmonary artery which constitute the fundamental shadow of the hilus are extremely variable. The radiographs we publish bear witness to that variability of design, the systematization of which is at present the object of our labours, and we hope to publish shortly an account of our work on the subject.

Certain diffused shadows and certain points of greater opacity which appear at times in the neighbourhood of the cardiac image or even at points remote from the hilus and the interpretation of which might give rise to doubts, are easily explicable by an angiopneumographic examination. As a rule they are due to superposition of vascular images. Thus, for instance, in the radiograph shown in Fig. 17, the opacity of the interventriculo-cardiac space, to the transparency of which some authors attach so much importance and which an ordinary radiograph explain, is shown by angiopneumography to be due to the presence of multiple ramifications directed inwards. Again, the greater opacity of small isolated spots in the depth of the parenchyma, which might be attributed to small sclerosed foci, are nothing more, as a rule, than vessels seen in the direction of their axis, or intercrossed. The greater intensity and clearness with which they are shown by the angiopneumographic examination permits the vascular origin of these shadows to be established.

Lastly, the angiopneumographic test reveals to us certain interesting aspects of the pulmonary circulation. Among these, for instance, is the lesser circulation in the parenchyma near sclerosed lesions and the slowness of the flow of blood and lesser repletion of the vessels in a collapsed lung (Fig. 16, 18, 20, 22, 24). Fig. 16, which shows the radiograph of a patient who entered hospital suffering from a sero-fibrinous pleurisy and was submitted to a thoracentesis followed by insufflation of air, is quite clear in that respect. As a matter of fact, in the angiopneumographic examination of the patient referred to, made at the moment in which the collapse was already insignificant, being limited to a band of air 1 or 2 centimetres in width, accumulated principally in the upper part of the thorax, the pulmonary circulation is more tenous on the left side, seat of the pneumo, than on the right, which on its part presents such richness of detail that the vascular branching may be followed as far as the finest excentric ramifications.

SUMMARY

After numerous experiments on rabbits, dogs and monkeys, the authors have succeeded in visualising the pulmonary vessels in man. The process consists in the injection, into the right auricle of the heart, of a highly concentrated (120 per cent.) solution of sodium iodide. The auricle is reached by means of a roentgen-

opaque probe, which is introduced into one of the cubital veins, its gradual advance being followed, radioscopically, on the screen. The probe has been sterilized beforehand, and kept in a sterile 10 per cent. solution of sodium citrate. Simultaneously with its introduction, small quantities of physiological serum are injected by means of a syringe fitted to its other end, in order to make the progress easier and prevent the formation of any blood-clot within the tube.

When the probe has been introduced, the roentgen apparatus is made ready for the taking of the roentgenograms, and the cassette is placed against the anterior side of the patient's thorax. The syringe used for the physiological serum is now exchanged for another, containing the sodium iodide solution. The patient is told to make a deep inhalation, after which he must remain absolutely without moving. The opaque solution is then injected as rapidly as possible, the injection being stopped as soon as from 6 to 8 cm³ have been introduced. The syringe is then once more exchanged for the one that contained the physiological serum, in order to withdraw from the probe the sodium iodide solution that might remain in the latter, and finally also the probe itself is gently withdrawn.

The patients subjected to this angiopneumographic examination do not experience any discomfort worthy of note from the operation. At most, there may be a brief spell of coughing when the injection is finished, and sometimes a slight headache, which soon disappears, however. To prove the value of the visualisation of the pulmonary vessels it suffices to compare, in each individual case, the plain roentgenograms with the corresponding angiopneumograms. The study of the two shows to evidence the scientific importance of this new process, as a means of roentgenographic interpretation in cases of pulmonary lesions.

ZUSAMMENFASSUNG

Nach zahlreichen Tierversuchen (an Kaninchen, Hunden und Affen) gelang es den Verfassern, auch beim Menschen die pulmonalen Gefäße sichtbar zu machen. Zu diesem Zweck injiziert man eine sehr konzentrierte Natriumjodidlösung (120 %) in das rechte Herzohr. Man erreicht dieses mit einer für Röntgenstrahlen undurchlässigen, in eine der Venen der Ellenbeuge eingeführten Sonde, deren Vordringen durch Radioskopie auf dem Schirm des Apparates verfolgt wird. Während die Sonde, die vorher sterilisiert und in einer sterilen 10 %igen Natriumzitratlösung bereitgehalten worden war, eingeführt wird, injiziert man mittels einer kleinen, an das andere Ende der Sonde angesetzten Spritze kleine Mengen physiologischer Salzlösung, um das Vordringen der Sonde zu erleichtern und Bildung eines Blutgerinnsels in ihrem Innern zu verhindern.

Ist die Sonde eingeführt, so wird der Röntgenapparat für die Röntgenaufnahme bereit gemacht, und die Kassette an die vordere Thoraxfläche des Kranken angelegt. Die kleine Spritze, mit der die physiologische Salzlösung injiziert worden war, ersetzt man durch eine andere mit Jodnatriumlösung gefüllte. Der Kranke wird aufgefordert, tief einzuatmen und danach absolut ruhig zu bleiben. Dann injiziert man möglichst rasch die Kontrastflüssigkeit, bis 6—8 cm³ eingeführt sind.

An Stelle der zur Injektion der Jodnatriumlösung benutzten setzt man wieder die mit physiologischer Salzlösung gefüllte Spritze an das Ende der Sonde, um den in dieser noch zurückgebliebenen Rest der Jodlösung auszutreiben, worauf die Sonde selbst langsam herausgezogen wird.

Die angiopneumographische Untersuchung bereitet dem Patienten keine nennenswerten Beschwerden. Höchstens kann ein kurzer Hustenanfall zu Ende

der Injektion und bisweilen leichter Kopfschmerz eintreten, die aber rasch wieder verschwinden.

Um einen Beweis für den Wert der Sichtbarmachung der Pulmonalgefäße zu erhalten, braucht man nur in jedem Falle die gewöhnlichen Röntgenogramme mit den betreffenden Angiopneumogrammen zu vergleichen. Eine eingehende Betrachtung beider zeigt zur Evidenz die wissenschaftliche Bedeutung dieses neuen Verfahrens als Mittel zur röntgenologischen Klarstellung bei Fällen von Lungenläsionen.

RÉSUMÉ

Après de nombreux essais sur des animaux de laboratoire (lapins, chiens et singes) les auteurs ont réussi à obtenir la visibilité des vaisseaux pulmonaires chez l'homme. Pour cela on injecte dans l'oreillette droite des solutions très concentrées d'iodure de sodium (120 p. 100). On atteint l'oreillette avec une sonde opaque aux Rayons X introduite dans une des veines du pli du coude, et dont la marche progressive est suivie sous radioscopie sur l'écran de l'appareil. La sonde, préalablement stérilisée et maintenue dans une solution stérile de citrate de soude à 10 p. 100, est alors introduite lentement, en même temps qu'on injecte de petites quantités de sérum physiologique, avec une seringue adaptée à l'autre extrémité, dans le but de faciliter la progression de la sonde et d'empêcher la formation de quelque caillot dans son intérieur.

Une fois la sonde introduite, on prépare l'appareil de Rayons X pour l'exécution de la radiographie et on place le châssis contre la face antérieure du thorax du malade. On remplace la seringue avec laquelle on injectait le sérum physiologique par une autre contenant la solution d'iodure de sodium. On commande au malade de faire une inspiration profonde, après laquelle il doit se maintenir immobile. On injecte alors rapidement la solution opaque et on fait le dé clic de l'ampoule au moment où 6 à 8 cm³. sont introduits.

Ensuite on adapte à nouveau, à l'extrémité de la sonde, la seringue au sérum physiologique, afin d'expulser le restant de la solution iodée qui y est contenue, et on la retire ensuite doucement.

Les personnes soumises à l'examen angio-pneumographique n'éprouvent aucune gêne qui vaille la peine d'être mentionné. Elles accusent tout au plus un accès passager de toux à la fin de l'injection, et parfois de légers maux de tête qui disparaissent rapidement.

Pour témoigner de la valeur de la visualisation des vaisseaux pulmonaires il suffit de comparer, pour chaque cas les radiographies simples avec les angio-pneumographies respectives. L'étude des deux démontre nettement la portée scientifique de ce nouveau procédé dans interprétation radiographique des lésions pulmonaires.



ON LIMY BILE¹

by

Folke Knutsson

(Tabulae LIX—LX)

In 1929 VOLKMANN reported on two peculiar gall-bladder cases. The gall-bladder was found to contain a peculiar thick fluid resembling milk chiefly consisting of calcium carbonate. In both cases the cystic duct was occluded by an impacted stone. The cases had not been radiographed. Cases of similar nature have subsequently created attention in radiological circles on account of the shadow caused to appear on the radiogram by the abnormally limy contents of the gall-bladder and have been described in greater detail by PHEMISTER, REWBRIDGE and RUDISILL (1931), in addition to which sporadic cases examined by roentgen have been published by e. g. MARKUS (1933).

In the cases the contents of the gall-bladder are of an amorphous nature, chiefly consisting of calcium carbonate and varying in consistence for different cases. In some cases it is made up of a white thin fluid which has caused VOLKMANN to give it the name of »lime-milk bile»; in other cases again it is more of a semi-solid consistence, like an ointment or paste, while at other times it is solid enough to be called a concretion. Sometimes it is white or yellowish in colour, at other times of a considerably dark-brown colour. In respect of the variation in colour as well as of the consistence of the gall-bladder contents concerned the term »lime-milk bile» must be considered inappropriate as a general term. PHEMISTER is using the term »calcium carbonate stone» but this expression is surely only warranted in such cases where the contents are sufficiently solid to justify their being called a concretion. In what follows I shall instead simply call it »limy bile», a term which from roentgenological point of view is quite satisfactory. By using this term, therefore, one does not commit oneself as to the consistency or colour of the contents but only wishes to denote their chief property of being abnor-

¹ Submitted for publication Aug. 10th, 1933.

mally limy, i. e. to such an extent as to appear as a dense (calcium-dense) shadow on the radiogram.

Such cases of limy bile must not be mistaken for so-called *cholecystitis calculosa* where the very gall-bladder wall itself is more or less calcified.

Clinical cases

Case I. Maria Hospital. B. k. 52. Female, aged 36, who for twelve months had been having indefinite abdominal symptoms and during the past two months attacks of pain every week.

Roentgen ex. March 2, 1922. Intensive calcium-dense shadow of the gall-bladder with several defects caused by layers of calcified concretions; one concretion, the size of a hazelnut, is found outside the gallbladder shadow at the site of the cystic duct (fig. 1).

Operation March 21, 1922 (KEY). Cholecystectomy. The gall-ladder was found to contain a porridge-like mass besides a few stones, one of which was impacted in the cystic duct. Radiogram of the specimen depicted in fig. 2.

Chemical ex. of gall-bladder contents March 23, 1922. These were found to be made up of calcium carbonate besides a slight amount of organic matter. Traces of bile-acids were found here. Neither oxalic nor inorganic acids were present (trace of chlorine), nor any other metals than calcium (HAMMARSTEN).

Case II. Maria Hospital, Ga. k. 144. Female, aged 20, with a history of painful attacks for three years, latterly every second week.

Roentgen ex. May 1, 1929. On the radiograms taken after oral administration of tetragnost there is seen a sickle-shaped shadow of the gall-bladder containing a number of concretion defects. The shadow is too dense to be caused by contrast medium and persists unchanged after a fatty meal (fig. 3).

Operation May 6, 1929 (KEY). Cholecystectomy. Long and narrow gall-bladder containing a pasty yellow mass and a number of stones, as large as peas, of typical cholesterin character. One of them was found to be impacted in the cystic duct. Radiogram of the specimen depicted in fig. 4.

Histological report. Slight signs of chronic inflammation of gall-bladder. Fairly powerful hypertrophy of musculature, no cholesterin deposit in the submucosa (WAHLGREN).

Case III. Maria Hospital, Ga. k. 301. Female, aged 49, with twelve month's history of painful attacks in the epigastrium.

Roentgen ex. Jan. 16, 1933. Radiograms taken after oral administration of tetragnost. At the site of the gall-bladder there is seen a calcium-dense shadow, the size of a shell-almond; within this can be seen small rounded attenuations probably made up of cholesterin calculi, surrounded by limy bile (fig. 5).

Operation Jan. 18, 1933 (KEY). Cholecystectomy. The gall-bladder was of ordinary size and had thick walls. It contained besides a slimy thin and clear bile, lumps of a pasty yellow-white mass (limy bile). In addition there were in the gall-bladder one typical cholesterin calculus and several others of smaller size (fig. 6).

Histological report. The wall of the gall-bladder is the seat of fairly well-marked chronic inflammatory changes, the mucous membrane is destroyed within

fairly large areas and the musculature is hypertrophic. The contents of the gall-bladder are rich in mucus and calcium deposits (WAHLGREN).

Case I V. Maria Hospital. Ga. k. 123, Male, aged 44, with twelve months' history of intensive attacks of pain about once every month.

Roentgen ex. Nov. 27, 1928 and April 10, 1930. Radiograms taken without tetragnost. Calcium-dense shadow of gall-bladder with obvious concretions. A couple of them impacted in the cystic duct (fig. 7).

Operation Sept. 5, 1930 (HELLSTRÖM). Cholecystectomy. Gall-bladder, the size of a goose-egg, with a thickened oedematous wall. In the cystic duct a calculus was found impacted.

Histological report. The wall of the gall-bladder shows mild chronic inflammatory changes and hypertrophy of the musculature (WAHLGREN).

Case V. Red Cross Nursing Home. Ga. k. 107. Female, aged 40.

Roentgen ex. Oct. 28 and Dec. 2, 1932. The first examination was carried out after oral administration of tetragnosts. On these pictures there is a dense gall-bladder shadow of ordinary size. Within this there can be seen a great number of small rounded concretion defects. The gall-bladder remained unchanged after fatty meal and on further surveying pictures taken on Dec. 2 without any opaque medium. (Fig. 8.)

Operation Jan. 24, 1933 (SÖDERLUND). Cholecystectomy. The gall-bladder had thin walls. Within was found a semi-solid mass, the size of a nut; this was of brown colour and could be shifted as a lump within the rest of the thin slimy and somewhat yellowish contents. This lump was calcified and to some extent of plastic nature which will be clear on comparing fig. 8 with the depicted specimen in fig. 9. Inside this lump there were a great many cholesterin concretions as large as peas. In addition there were a number of free partly calcified cholesterin calculi, as large as peas, and a great many flakes and granules likewise calcified.

Histological report. The epithelium of the mucous membrane is largely destroyed (? through autodigestion, ? post-operative autolysis) and only intact in patches. It is there covered with sticky deposits containing large phagocytes and limy flakes. The wall is partly hyalinized but shows no inflammatory changes worth mentioning. No muscular hypertrophy (WAHLGREN).

Chemical analysis Feb. 23, 1933. The brown tenacious scybalous mass mainly consisted of inorganic matter, chiefly calcium carbonate and on analysis the calculi proved to consist mainly of cholesterin. They were concentrically constructed and lacked nuclei (TEORELL).

Case V I. Maria Hospital, Ga. k. 280. Female, aged 37, with a history of attacks of pain for the past two years.

Roentgen ex. July 12, 1932. The pictures are taken after oral administration of tetragnost. On those taken in reclining position there can be seen a small shadow of the gall-bladder intensively dense, containing a number of round concretion defects (fig. 10). On the skiagrams taken in upright position the gall-bladder clearly holds two different kinds of bile, a heavier kind, dense as calcium, which forms a sediment at the bottom and a thinner kind of bile above the former. There is a horizontal line of demarcation between these two layers. On the upright pictures there are no concretion defects in the dense bile, the concretions having apparently on account of their lower specific weight distri-

buted themselves within the thin non-opaque bile (fig. 11). The roentgen pictures remain unchanged after fatty meal and on the following day.

Operation July 13, 1932 (HELLSTRÖM). Cholecystectomy. Thick-walled gall-bladder. A couple of small concretions could be palpated in the neck of the bladder. Fig. 12 is a photograph of the specimen with the gall-bladder hanging in such a manner as to cause the sediment of the limy bile to sink to the bottom.

Chemical analysis, July 1932. The specimen submitted considered partly of a number of yellow-white calculi made up of cholesterin with slight admixture of lime and phosphates, partly of a grey-yellow semi-solid mass. Besides normal bile this mass proved to contain some stuff soluble in acid mainly consisting of calcium carbonate in addition to some organic matter holding iodine in fairly large quantities. (THEORELL.)

Case VII. Maria Hospital, Ga. k. 278. Female, aged 33, who a month ago was taken ill with attacks of abdominal pains, rigors, fever and icterus.

Roentgen ex. July 9, 1932. On radiograms taken after oral administration of tetragnost there can be seen a small, intensively dense gall-bladder shadow which persists after fatty meal and also on the following day. It is clear therefore that it cannot be caused by the contrast medium but depends upon limy contents of the gall-bladder. In this limy bile can be seen two small rounded concretions in addition to a concretion as large as a pea located in the cystic duct (fig. 13). In upright position the limy bile forms a sediment at the bottom with a nearly horizontal upper level, an upper non-opaque layer of bile being presumably superimposed above (fig. 14).

Operation July 11, 1932 (HINDMARSH). Cholesystectomy. Gall-bladder small, thick-walled and containing a calculus. It contained a clear bile besides yellow-green flakes and an amorphous mass.

Histological report. The wall of the gall-bladder shows moderately well-marked chronic inflammatory changes and a considerable muscular hypertrophy (WAHLGREN).

Case VIII. Maria Hospital, Ga. k. 249. Female, aged 24, with a 10-year history of sporadic attacks of pains.

Roentgen ex. Nov. 27, 1931. Radiograms taken after oral administration of tetragnost show a very dense gall-bladder shadow with a great number of small rounded concretions. This shadow persisted unaltered after a fatty meal and on the strength of the roentgen ex. a diagnosis was made of cholesterin concretion within limy bile (fig. 15).

Operation Jan. 21, 1932 (KEY). Cholecystectomy. Thin-walled gall-bladder containing calculi as large as grains, besides one stone impacted in the cystic duct. The bile was thick and mucous.

Histological report. The wall of the gall-bladder shows slight, chronic inflammatory changes and considerably muscular hypertrophy (WAHLGREN).

Case IX. Maria Hospital, Ga. k. 116. Female, aged 42, who for some indefinite time had been having sporadic attacks of biliary colic.

Roentgen ex. Sept. 21, 1928. On examination with tetragnost the gall-bladder filled up in a normal manner and two hours after the fatty meal most of it was empty. In upright position (fig. 16) a group of filling defects can be seen in the fundus owing to cholesterin calculi having sunk to the bottom. Underneath this stony layer there is an intensively dense curved zone probably due to limy bile



Fig. 4 (Case II)

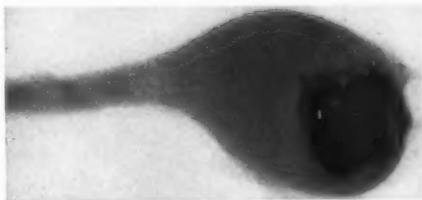


Fig. 9 (Case V)

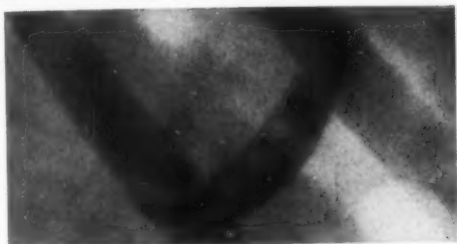


Fig. 3 (Case II)

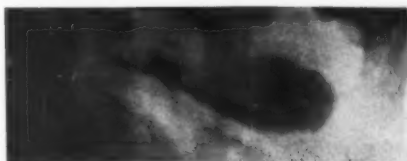


Fig. 8 (Case V)



Fig. 2 (Case I)

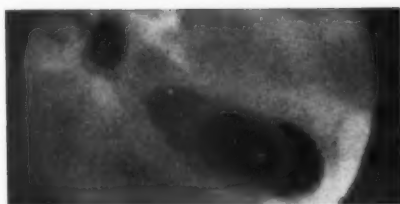


Fig. 7 (Case IV)



Fig. 1 (Case I)

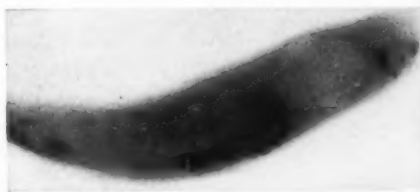


Fig. 6 (Case III)

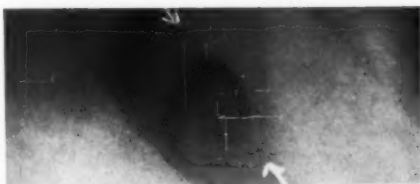


Fig. 5 (Case III)





Fig. 14 (Case VII)



Fig. 13 (Case VII)

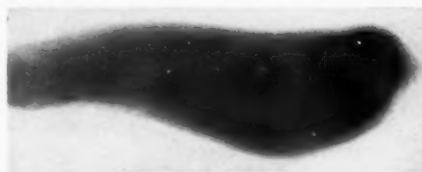


Fig. 12 (Case VI)

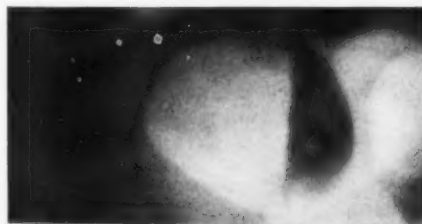


Fig. 11 (Case VI)

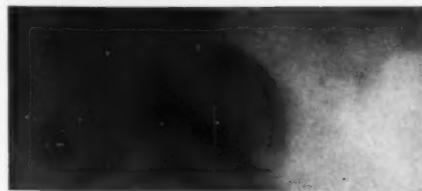


Fig. 10 (Case VI)



Fig. 19 (Case XII)

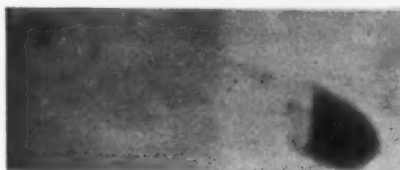


Fig. 18 (Case XI)

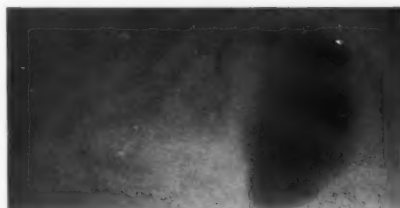


Fig. 17 (Case X)



Fig. 16 (Case IX)

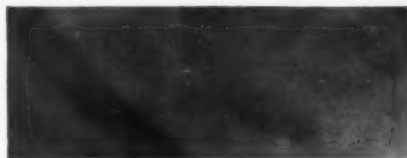


Fig. 15 (Case VIII)





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which forms a bottom layer with an upper horizontal surface against the normal opaque bile, in the bottom layer of which the calculi are located.

Operation Oct. 15, 1928 (KEY). Cholecystectomy. A somewhat enlarged gall-bladder in which were found thirteen small nodulous stones (there are no notes in the operation report regarding the nature of the bile).

Histological report. Slight signs of chronic inflammation of the mucous membrane of the gall-bladder (WAHLGREN).

Case X. Maria Hospital, Ga. k. 297. Female, aged 29, with a history of attacks of pains for the past two years.

Roentgen ex. Dec. 3, 1932. On the radiograms which were taken after oral administration of tetragnost can be seen in reclining position an intensively dense gall-bladder shadow with a great number of small concretion defects. In upright position the calcium-dense contents of the gall-bladder collect in the fundus and obtain a horizontal upper level which presupposes the presence of a superimposed thinner nonopaque layer of bile. After a fatty meal the gall-bladder shadow persisted unaltered (fig. 17).

Operation May 26, 1933 (KEY). Cholecystectomy. Gall-bladder rather small with thickened wall. A couple of concretions were impacted in the cystic duct. The gall-bladder contained a yellow-white pasty mass in which were embedded small rugged concretions largely apparently made up of pigments.

Histological report. The wall of the gall-bladder shows chronic inflammatory changes of a moderate degree and powerful hypertrophy of the musculature (WAHLGREN).

Case XI. Maria hospital. Ga. k. 286. Male, aged 30, who for the past eighteen months has been having three painful attacks of gall-stone type.

Roentgen ex. Sept. 7, 1932. The radiograms taken after oral administration of tetragnost. In fig. 18 taken in upright position there is seen in the gall-bladder a limy bottom layer with a horizontal upper level. Above this there is certainly a layer of a thinner non-opaque bile only containing a few limy flakes. In the cystic duct a calcified concretion is seen to be impacted.

Operation May 18, 1933 (KEY). Cholecystectomy. Fairly small gall-bladder with a thickened wall. The gall-bladder perforated and in so doing it emitted first a treacly clear fluid resembling the white of an egg then a creamy pasty sort of mass resembling the opaque barium porridge. A stone was impacted in the cystic duct and in the gall-bladder there was still another small limy concretion.

Histological report. The wall of the gall-bladder shows well-marked chronic inflammatory changes and powerful muscular hypertrophy (WAHLGREN).

Case XII. Maria Hospital. Ga. k. 319. Male, aged 40, with i definite abdominal pains for three years, often of colicky nature. During the past twelve months been having attacks of pains to the left in the abdomen and the back.

Roentgen ex. May 15 and 18, 1933. At the site of the gall-bladder there is a reticular calcium-dense structure occupying an area about as large as the end of the thumb, apparently limy bile with concretion defects. No contrast filling on cholecystography.

Operation May 22, 1933 (HELLSTRÖM). Cholecystectomy. Gall-bladder somewhat large and thick-walled. It contained a great quantity of concretions



which forms a bottom layer with an upper horizontal surface against the normal opaque bile, in the bottom layer of which the calculi are located.

Operation Oct. 15, 1928 (KEY). Cholecystectomy. A somewhat enlarged gall-bladder in which were found thirteen small nodulous stones (there are no notes in the operation report regarding the nature of the bile).

Histological report. Slight signs of chronic inflammation of the mucous membrane of the gall-bladder (WAHLGREN).

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Operation May 26, 1933 (KEY). Cholecystectomy. Gall-bladder rather small with thickened wall. A couple of concretions were impacted in the cystic duct. The gall-bladder contained a yellow-white pasty mass in which were embedded small rugged concretions largely apparently made up of pigments.

Histological report. The wall of the gall-bladder shows chronic inflammatory changes of a moderate degree and powerful hypertrophy of the musculature (WAHLGREN).

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Histological report. The wall of the gall-bladder shows well-marked chronic inflammatory changes and powerfull muscular hypertrophy (WAHLGREN).

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Roentgen ex. May 15 and 18, 1933. At the site of the gall-bladder there is a reticular calcium-dense structure occupying an area about as large as the end of the thumb, apparently limy bile with concretion defects. No contrast filling on cholecystography.

Operation May 22, 1933 (HELLSTRÖM). Cholecystectomy. Gall-bladder somewhat large and thick-walled. It contained a great quantity of concretions

besides a thick treacly yellow-green bile and in the fundus a pasty grey-white limy bile (fig. 19).

Histological report. The wall of the gall-bladder shows atrophy and connective tissue induration of the mucous membrane and powerful hypertrophy of the musculature. Cicatrization after cholecystitis (WAHLGREN).

The clinical list thus include twelve cases of limy bile which all have been subject to operation. The clinical histories and the clinical pictures have varied in a way generally characteristic of gall-bladder affections, the pictures including several or a lesser number of more or less severe attacks of pain. Among the above twelve cases there is no clinical characteristic symptom throughout that is not to be found in other affections of the gall-bladder or which dominates in a way to establish a clinical picture characteristic of limy bile. It is worthy of note, however, that all the patients have had true gall-stone attacks and not only diffuse gnawing pains which fact agrees well with concretions having been found in all cases (vide however case XII).

In all the cases the limy bile has varied considerably in *colour*, from dark brown to yellow or whitish. In no case has the limy bile been of such a solid *consistence* as to form a true concretion, it having instead generally consisted of a semi-solid mass or several semi-solid lumps and flakes. *In addition to this limy bile the gall-bladder in most cases also contained a clear, light-coloured and hydropic bile.*

On roentgen examination the limy bile yields an intensively dense shadow which in some cases has the typical shape of the gall-bladder. Such a pear-shaped form of the gall-bladder shadow may arise in two different ways:

1) The gall-bladder is entirely occupied with a more or less solid homogeneous limy bile; in this defects are seen resulting from concretions. There is no thin hydropic bile (cases I, II and IV). In these cases there is no sedimentation which may cause different appearances of the gall-bladder shadow in different positions, the shadow obtaining a characteristic pear-shape in all positions.

2) The gall-bladder contains a more or less thick limy bile besides a thin clear hydropic non-opaque bile. In the gall-bladder the limy bile forms sediment at the bottom and obtains a horizontal upper level and above this we find the thin bile. In roentgen examination with the patient in lying position the precipitated limy bile may for obvious reasons give rise to a dense shadow which may adopt a typical gall-bladder shape. In upright position, on the other hand, the double contents of the gall-bladder become clearly in evidence by the fact that saturated limy content at the bottom obtains a horizontal upper level, above which the thin non-opaque bile is located (cases V, VI, VII, X and

XI). *This sedimentation as it appears in upright position is of direct value for the diagnosis.*

Unfortunately, however, such a shadow of limy bile met with on radiograms at cholecystography may be mistaken for a normal shadow of contrast (e. g. fig. 8, 10 and 13). By examining, however, the gall-bladder *lege artis* with pictures in upright position, showing sedimentation of the limy bile, and with pictures taken after a fatty meal such confusion is not likely to occur.

In all the cases typical cholesterin calculi have been present. (In case X, however, the cholesterin character is uncertain.) On roentgen examination these have often appeared as rounded defects in the limy bile but in other cases when not embedded in the limy bile they have escaped the roentgen diagnosis, unless, as happened in some cases, they did not possess any calcified structure or had a superficial calcium deposit.

In nine of the cases *the cystic duct was occluded by an impacted calculus.* Regarding the three remaining cases there is no statement in the operation-report as regards any impacted stone.

The gall-bladder was generally of small size and in no cases was there any dilatation. On microscopical examination mild or moderate *chronic inflammatory changes were found in the wall of the gall-bladder in all the examined cases* (vide, however, case V) in addition to which it was noted in the majority of cases that the *musculature was obviously hypertrophic*. This muscular hypertrophy is clearly caused by increased contractile work of the gall-bladder and directly occasioned by the impacted calculus in the cystic duct.

In those cases where cholecystography was carried out there was no evident filling of the gall-bladder of contrast medium except in one case, viz. case IX. In this case the gall-bladder filled up with contrast medium and emptied itself in a normal manner and the supposed-to-be limy bile formed a minimal sediment at the bottom above which a number of cholesterin calculi were found located. This case would seem to illustrate the very first phase of the process which leads to precipitation of lime in the gall-bladder.

In the typical cases of limy bile we have thus found impacted calculi in the cystic duct, chronic inflammatory changes in the wall of the gall-bladder and hypertrophy of the musculature. This muscular hypertrophy is a sign of aggravated difficulties for the gall-bladder to empty itself, a condition which has persisted for a long time. One would seem justified to consider this long-delayed emptying or entirely inhibited emptying of the gall-bladder in conjunction with inflammatory changes in the gall-bladder wall as necessary conditions for the production of limy bile.

There is still no clear conception as regards the closer physiological and chemical procedure in the formation of limy bile. Thus PHEMISTER assumes the lime to be *secreted* through the gall-bladder wall to the bile; it cannot therefore arise from the bile itself and he suggests that it accompanies the secretion of mucus and pus. As far as I am aware there is no experimental evidence to show that a normal gall-bladder wall is able to secrete calcium to the bile. On the contrary experiments have proved calcium to be absorbed by the blood via the gall-bladder wall (MIRVISH, SACKS, SCHIRE, ANDREWS, HRDINA). We know moreover that an acute impaction of calculi in the cystic duct leads to dilation of the gall-bladder with a clear hydropic bile which proves to be much poorer in lime than normal bile. Naturally it is quite conceivable that such an abnormal function of the mucous membrane of the gall-bladder with excretion of lime may occur in inflammatory changes.

Normal bile contains about 20 mgm% calcium, i. e. twice the amount of the blood which is nearly saturated. The lime is considered kept in solution by cholesterin and bile-salts (FOWWEATHER, COLLINSON). *Precipitation* of lime may thus conceivably be due either to reduction of the bile-salts or the cholesterin contents of the bile. A disturbance of that nature in the composition of the bile may conceivably be secondary to the chronically inflammatory changes in the wall of the gall-bladder with alteration of its absorptive and excretory function. The impaction of impacted calculi may have caused a valvular closure of the cystic duct, not preventing inflow of bile but hampering its outflow, thereby causing a higher concentration of the bile. The great quantity of lime would not therefore necessitate secretion through the wall but might really be conceived as having arisen through precipitation from the bile itself since this, through valvular closure of the cystic duct, may have free access to the gall-bladder but a hindered outflow.

SUMMARY

The author submits an account of 12 cases of limy bile, all operated on. In these cases the bile contained an amorphous precipitation of lime mainly consisting of calcium carbonate. This limy mass is fluid or of more semi-solid or solid consistence and its colour varies from whitish to dark brown. The author suggests these limy contents of the gall-bladder to be called simply »limy bile» in difference to the terms previously used, such as »calcium-milk bile» (VOLKMANN) and »calcium carbonate stone» (PHEMISTER). The limy bile gives rise to an intensively dense shadow of the gall-bladder which is not to be confused with the normal filling with contrast medium in cholecystography. As a rule the gall-bladder further holds an hydropic clear bile in which the limy bile sinks to the bottom. This double content of the gall-bladder appears in full evidence in pictures taken in upright position when the limy bile obtains a horizontal upper level.

In all the cases one found cholesterol calculi which appeared as filling defects in the limy bile or else appeared as a result of a calcified structure of the nucleus or superficial layer. Most often a stone was found impacted in the cystic duct. The wall of the gall-bladder has showed on microscopical examination chronic inflammatory changes and hypertrophy of the musculature.

Finally the author discusses the conceivable ways in which limy bile may arise.

ZUSAMMENFASSUNG

Verf. berichtet über 12 Fälle von Kalkgalle, die alle operiert wurden. Die Gallenblase enthält bei diesen Fällen einen amorphen Kalkniederschlag, der hauptsächlich aus Kalziumkarbonat besteht. Diese Kalkmasse ist von flüssiger oder mehr halbfester beziehungsweise fester Konsistenz, und ihre Farbe variiert von weisslich bis dunkelbraun. Verf. schlägt vor, diesen kalkhaltigen Gallenblaseninhalt einfach Kalkgalle zu nennen, zum Unterschiede von den früher verwendeten Bezeichnungen Kalkmilchgalle (VOLKMANN) und Kalziumkarbonatstein (PHEMISTER). Die Kalkgalle ruft einen intensiv dichten Gallenblasenschatten hervor, der nicht mit normaler Kontrastfüllung bei Cholezystographie verwechselt werden darf. In der Regel enthält die Gallenblase ausserdem eine hydropische klare Galle, in der die Kalkgalle sich auf den Boden absetzt. Dieser doppelte Gallenblaseninhalt tritt auf Bildern, die in stehender Stellung aufgenommen sind, wobei die Kalkgalle ein horizontales oberes Niveau erhält, markant hervor.

In allen Fällen fand man Cholesterinsteine, die als Füllungsdefekte in der Kalkgalle oder infolge ihrer kalkhaltigen Kernstruktur resp. Oberflächenschicht hervortraten. Meistens sass ein Stein in den Zystikus eingekleilt. Die Gallenblasenwand wies bei mikroskopischer Untersuchung chronisch entzündliche Veränderungen und Hypertrophie der Muskulatur auf.

Schliesslich erörtert Verf. die Ursachen, die für die Entstehung der Kalkgalle in Betracht kommen können.

RÉSUMÉ

L'auteur communique 12 cas, tout opérés, de bile calcaire. La vésicule biliaire renferme, dans ces cas, un précipité calcaire amorphe, en majeure partie constitué par du carbonate de calcium. Cette masse calcaire est, ou bien fluide, ou demi-fluide, ou plus consistante et sa coloration varie d'une teinte blanchâtre au brun foncé. L'auteur propose pour ce contenu calcaire de la vésicule la dénomination de «bile calcaire», à la différence des dénominations antérieurement usitées de «lait de chaux biliaire» (VOLKMANN) ou de calcul de carbonate de chaux (PHEMISTER). La bile calcaire donne lieu à une ombre intense et épaisse qu'il ne faut pas confondre avec l'ombre de contraste normale dans la cholécystographie. En règle générale, la vésicule contient en outre une bile claire hydropique, dans laquelle la bile calcaire se sédimente au fond de la vésicule. Ce double contenu cystique apparaît nettement sur les radiographies prises en position orthostatique, auquel cas la bile calcaire présente un niveau supérieur horizontal.

Dans tous les cas, on a trouvé des calculs de cholestérine, apparaissant comme des lacunes de remplissage dans la bile calcaire ou comme des stratifications superficielles, grâce à leur structure nucléo-calcaire. On a constaté fréquemment la présence d'un calcul enchassé dans le canal cystique. A l'examen microscopi-

que, la paroi cystique présentait des lésions inflammatoires et une hypertrophie de la musculature.

L'auteur discute enfin les causes probables tendant à produire la bile calcifiée.

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THE ROENTGEN PICTURE OF THE EPIPHARYNX OF CHILDREN UNDER NORMAL CONDITIONS AND BY ADENOID VEGETATIONS¹

by

Karl-Erik Groth

(Tabulæ LXI—LXIII)

The clinical diagnosis of adenoid vegetations in the epipharynx is generally rather easy. The affection gives symptoms which, in typical cases, even make possible its recognition at the first instant (DENKER und KÄHLER, LUST). These symptoms: adenoid facies, impediments by respiration through the nose, sleep with an open mouth, disturbances of speech and hearing, disposition for rhinopharyngitis etc. are, however, not pathognomonic for the hyperplastic pharyngeal tonsil and do not exclude a wrong diagnosis. They can be at hand at every process which brings on a chronic stenosis of the passage through the epipharynx or the nose. To ensure the diagnosis a proving of the adenoid is generally demanded, which is made clinically by aid of anterior and posterior rhinoscopy, and digital palpation through the mouth. As to the reliability of these methods of examination opinions seem to differ.²

In the majority of cases, anterior rhinoscopy will give a good result to an examiner who is used to the method, especially if, before the examination, the mucous membrane of the nose is made anaemic and brought to decrease in thickness, for instance by insertion into the nose of wads, moistened in novocain-adrenalin solution.

Posterior rhinoscopy can hardly be carried out on small children, whereby the usefulness of the method for the proving of adenoid is highly reduced.

The easiest examination, from a technical point of view, the palpation through the mouth, often causes bleeding from the adenoid, and

¹ Submitted for publication July 8th, 1933.

² In order to make clear this question there is at present a comparative clinical-roentgenologic examination going on by co-operation between the ear-nose-throat-clinic and the roentgen department here in Upsala.

is undoubtedly a very disagreeable experience for the little patients, in some cases accompanied by psychic trauma. The disadvantages of this method are emphasized, amongst others, in the exposition of the use of the methods which DENKER and KÄHLER have given in their manual, and they recommend to the examining physician to desist from palpation and leave the execution of it to the operator. Yet, JACKSON and COATES, LUST and others consider the examination as in many cases indispensable, and they minutely describe the manner of proceeding. If there exists an adenoid, the palpating finger meets with a soft, padlike swelling in the epipharynx. There exists, however, such a swelling already under normal conditions to a certain degree on account of the not enlarged pharyngeal tonsil.

Naturally, the above-mentioned clinical examinations complete each other. Thus there are patients on which, from some reason, the posterior pharyngeal wall can not be inspected through the nose even after deswelling of the mucous membrane of the nose, and on which an adenoid can consequently not be diagnosed by anterior rhinoscopy; in this case we might instead try with palpation. On the other side, as has already been mentioned, by palpation of the very soft tonsillar tissue it is in many cases impossible to decide to a certainty if there is a hyperplasia at hand or not. Under such conditions a roentgen examination can give a decision and prevent that an abrasion is unnecessarily made, as may sometimes happen. The roentgen examination gives namely a clear picture of the size of the adenoid and of the space in the epipharynx. Besides, this examination is very gentle, as it can be made even on sleeping children. Therefore, it seems to me to be fit to replace the more brutal palpation through the mouth.

That adenoid vegetations can be seen on roentgen was pointed out by MIGNON (Paris) already in 1898. He examined a case before and after abrasion. After the operation he found that the light pharyngeal room which only extended to the soft palate before the operation, now also embraced the nasopharynx, «ou s'implantaient les végétations». A certain difficulty in examining the conditions in the epipharynx by roentgen is pointed out by MIGNON, and he adds that roentgen examination did certainly not seem fit to replace rhinoscopy and palpation, but that it were, in certain cases, a good diagnostic aid. MIGNON's slight estimation of roentgen evidently is connected with the great technical difficulties at this time to obtain roentgenograms fit for use.

Also SCHEIER (Berlin) has given, in *Traité de radiologie*, published by BOUCHARD in 1904, a short description of the epipharynx with adenoid vegetations in small children, and has compared it to the appearance after abrasion. According to SCHEIER is seen «une ombre plus foncée que chez

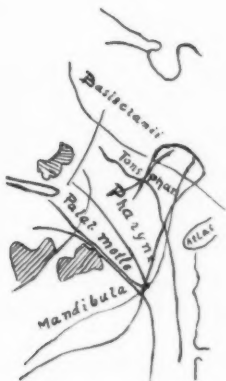


Fig. 1.¹ Normal epipharynx in five year old child. Sitting position. Horizontal direction of rays.

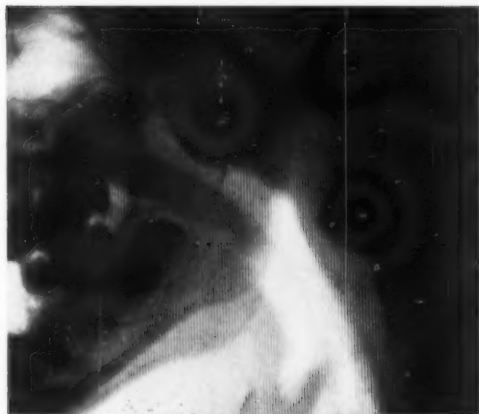


Fig. 2. Epipharynx with adenoid vegetations in six year old child. Recumbent position. Horizontal direction of rays.

¹ The soft parts appear more distinctly on the original pictures than on the reproductions.





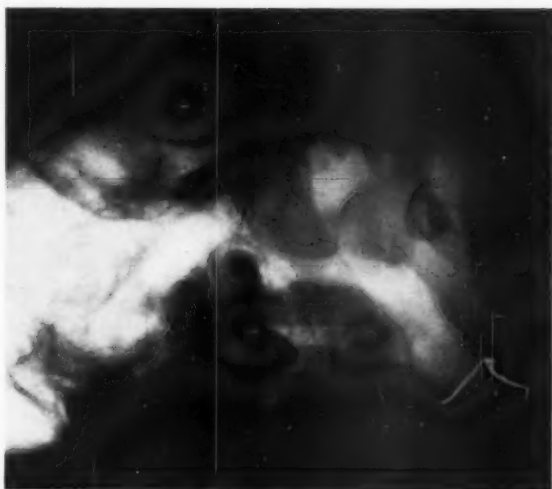


Fig. 3. Epipharynx with adenoid vegetations. Before the falling asleep.

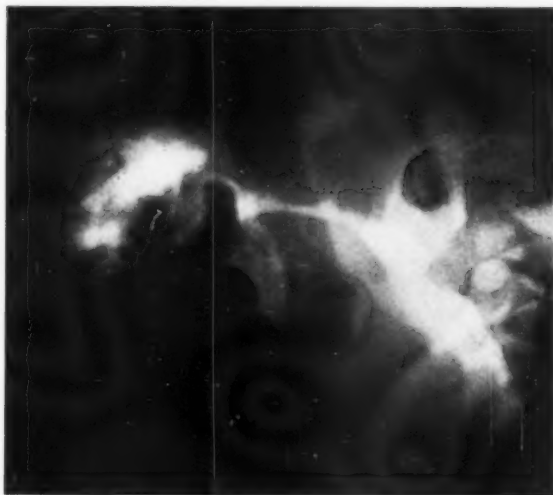


Fig. 4. Same patient as on fig. 3. During sleep.





Fig. 5. Epipharynx with voluminous adenoid vegetations in a thirteen year old child, roentgenogram a few hours before operation. Sitting position.

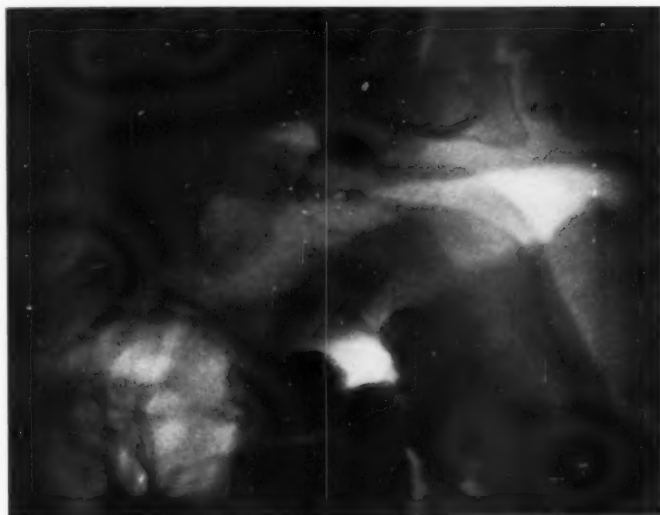


Fig. 6. Same patient as on fig. 5. Roentgenogram a few hours after operation. Sitting position.



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des individus normaux. Après leur extirpation cette ombre disparaît sur l'écran.»

These two authors seem to have made their observations by screening, and they do not publish any illustrations. In modern roentgenologic textbooks and manuals the epipharynx is only cursorily mentioned (SCHINZ, GOLDHAM), or not at all, apparently because it has been considered that the clinical methods of examination give so good information that roentgen examination is unnecessary. In a work on malignant tumors in the pharynx and larynx ZUPPINGER has pointed out the importance of roentgen examination as a diagnosticum and for the control of a therapeutic effect, and gives a normal picture of the epipharynx after opaque filling with lipiodol and roentgenography with the head hanging down. In the otorhinolaryngological as well as in the pediatric literature of manuals roentgen examination does not seem to have been taken into consideration for the diagnosis of adenoid vegetations.

At the roentgen department here in Upsala adenoid vegetations have since long occasionally been observed on the profile picture of the head which are taken by routine by examination of the sinuses, and on these pictures it has also been possible to see the relation of the adenoid to the soft palate and to the posterior nasal aperture. Lately the author has examined by roentgen, by the presence of adenoids, to what extent the passage in the epipharynx is affected by different positions of the head and by sleep.

It is the profile picture which is best suited for the study of these relations. Here the contours of the posterior pharyngeal wall and of the soft palate clearly appear without any insertion of opaque mediums. Satisfactory pictures are obtained by roentgenography with short (50 cm.) tube distance and the film close by the head. The soft parts can, however, be brought to appear still more distinctly, if the focus distance is increased, and the film placed at some distance from the head, by which is gained that the secondary radiation is to a great extent avoided. (LAURELL.) In the pictures reproduced here the tube distance has been 1 m., the film distance 20 cm. The exposition about 0.7 seconds by about 105 K. V. and 100 M. A. Also with »LYSHOLM's raster» distinct pictures are obtained.

Fig. 1 shows normal conditions in the epipharynx of a five year old girl. The air-containing pharyngeal lumen appears on the positive as a light string, which continues into the oral cavity, and which can be traced until it continues into the nasal cavities above the soft palate. The latter again appears as a tap-formed shadow between the pharynx and the oral cavity. The posterior pharyngeal wall and the adjacent, not bone-dense, tissues (as cartilage) are by children seen in the shape of a narrow shadow in front of the nucleuses of the vertebra bodies.

It is of a rather uniform breadth and without great irregularities in the front contour. The passage in the epipharynx is broad and spacious. By comparison between pictures taken in prostrate, recumbent, side and sitting position we find that the form and width of the epipharynx is affected only inconsiderably by the different positions of the head. (In recumbent position the width becomes slightly more narrow than in an upright and a prostrate position.) On account of this I only reproduce a normal picture — in sitting position.

By adenoid vegetations in the epipharynx the roentgen picture presents quite another appearance. Fig. 2 shows such a case, a six year old boy roentgenographed in recumbent position with horizontal direction of the rays. The posterior pharyngeal wall and adjacent, not bone-dense, tissues which appear below the atlas bow as a shadow of practically uniform breadth show proximally, between the bone in the spinal column and the air in the pharyngeal lumen, in the position of the pharyngeal tonsil, a considerable swelling. The breadth of the shadow from the bone mass of the bases of the skull to the pharyngeal lumen is about 4 times as great as the corresponding distance below the atlas bow. Towards the posterior nose aperture the swollen section ends in a bow which is convex forwards. This shadow which projects itself on the ascending rami mandibulae, has a slightly lobated free surface and represents chiefly the hyperplastic pharyngeal tonsil. The soft palate appears as a string-shaped shadow, narrowing backwards, below the adenoid, separated from it by a narrow air lumen, indicating the narrowed epipharynx passage. In the sagittal plane this passage is narrowest in the front where the convex anterior limitation of the adenoid begins. The free, posterior part of the soft palate, the uvula, lies in this position rather near the posterior pharyngeal wall, so that we get wrongly the impression that there exists also a posterior narrow passage, which is situated below the adenoid. Separated from the soft palate by a thin layer of air, the oral cavity, is seen the rounded upper-posterior contour of the tongue.

On pictures taken in a prostrate, or sitting position or lying on the side the adenoid and the soft palate keep practically the same look as in recumbent position, so that the form and width of the epipharynx seem to be practically constant; possibly its sagittal width is greater than in recumbent position, but the variation in the pictures does not amount to 1 mm. The uvula, in these positions, lies somewhat more forwards, and the pictures do not give the impression of any posterior narrow passage. On account of the similarity between the pictures by different position of the head also by the existence of adenoid vegetations only one picture is given — in recumbent position — to illustrate the narrowing of the passage.

Thus, it seems as if the musculation in different positions of the body keeps the soft palate (in repose) fixed in a rather unchanged position in relation to the posterior and upper epipharyngeal wall, whereby the air passage is kept the same to a certain degree also by rather great adenoids.

In order to get an idea, if an enervation of the musculation of the soft palate plays any rôle for the form and width of the passage of the epipharynx, the author has made comparative roentgen examinations of the pharynx in waking condition and during natural sleep under observance of exactly the same technical proceeding and with the same position of the head in both cases. These examinations were made in such a manner that the patient was left to fall asleep on an examination table of the roentgen department after all adjustments were made, and a picture had been taken in recumbent position with horizontal direction of the rays. When the patient had been profoundly asleep for about an hour, the head was cautiously placed, without waking the patient, in the same way as before in recumbent position, when the respiration became snoring. In this position a new picture was taken in the same way as before the falling asleep of the patient. Figures 3 and 4 show the results of such an examination. The similar projection of the two pictures of the ascending rami mandibulae is proof that the adjustment at the two expositions has been the same, and that the pictures are consequently directly comparable. An obvious difference in the width of the passage can easily be stated by comparison of the pictures. The shadow of the soft palate seems, during sleep, to have increased in thickness and decreased in length. By this it has approached the adenoid, so that a minimum stripe of air remains of the epipharynx lumen. During sleep the epipharynx does not, however, show a narrow passage, embracing only the front part of the adenoid, but the soft palate has placed itself close to the surface of the adenoid in all its extension. It thus appears that the contraction condition in the musculation of the soft palate, totally or partly suspended during sleep, makes possible its sinking down — in recumbent position — towards the adenoid, by which the passage through the epipharynx is more or less totally narrowed. Probably the passage gets more free during sleep in prostrate position, which may explain that some patients with adenoids often sleep in this position.

Finally I give a few pictures of a thirteen year old girl who showed clinically and roentgenologically a great adenoid. The pictures are taken some hours before and some hours after an abrasion. Fig. 5 proves that the lumen of the epipharynx is totally removed on account of the voluminous adenoid which reposes against the soft palate and the posterior nasal openings. The passage from the mouth to the pharynx is rather broad on the picture, because the patient chiefly breathed through

the mouth. After exstirpation of the great adenoid, the epipharynx room is seen, on fig. 6, to be air-containing and the passage is broad.

SUMMARY

The roentgen picture of the epipharynx by children under normal conditions and by the presence of adenoid vegetations is described. The breadth and form of the epipharynx is, as a whole, but slightly affected by the position of the head. During sleep, on the other hand, the passage is considerably narrowed by the fact that the soft palate places itself close to the adenoid, which is made possible by a diminished or suspended contraction condition in the musculature of the palate. Roentgen examination which is made without annoyance to the patient ought by children to substitute the more brutal and disagreeable palpation through the mouth. It is better suited than the palpation to give an idea of the diminution of space in the epipharynx, arisen through the existence of the adenoid.

According to the author's opinion, roentgen examination ought always to be made, if possible, by the suspicion of adenoid vegetations in those cases, when on some account the posterior pharyngeal wall can not be inspected by aid of anterior rhinoscopy.

ZUSAMMENFASSUNG

Es wird das Röntgenbild des Epipharynx bei Kindern unter normalen Verhältnissen und in Gegenwart adenoider Wucherungen beschrieben. Der Durchmesser und die Form der Epipharynxpassage werden im wachen Zustand nur wenig durch die Stellung des Kopfes beeinflusst. Dagegen wird im Schlafe die Passage in der Rückenlage stark dadurch verdrängt, dass sich das Palatum molle an die adenoiden Vegetationen legt; dies wird durch Herabsetzung oder Aufhebung des Kontraktionszustandes der Gaumenmuskulatur ermöglicht. Die Röntgenuntersuchung, die ohne Unannehmlichkeit für den Patienten durchgeführt wird, hat bei Kindern die derbere und unbehaglichere Palpation durch den Mund zu ersetzen. Sie ermöglicht es besser als die Palpation, sich von der durch die Wucherungen entstandenen Raumverringern im Epipharynx eine Vorstellung zu bilden.

Die Röntgenuntersuchung ist nach der Ansicht des Verfassers womöglich stets beim Verdachte adenoider Wucherungen in denjenigen Fällen auszuführen, in welchen die hintere Schlundwand aus irgendeinem Grunde nicht mittels der vorderen Rhinoskopie untersucht werden kann.

RÉSUMÉ

L'image radiologique du pharynx nasal chez des enfants est décrite d'une part dans des conditions normales et d'autre part en présence de végétations adénoïdes. Quand le sujet est éveillé, la largeur et la forme du passage du pharynx nasal sont généralement très peu influencées par la position de la tête. En dormant, au contraire, en décubitus dorsal, le passage est fortement rétréci parce que le voile du palais se pose tout près de la végétation adénoïde, ce qui est possible par un état de contraction affaibli ou supprimé de la musculature du palais.

L'examen radiologique, qui est fait sans aucun désagrément pour les malades, doit pour les enfants remplacer la palpation par la bouche qui est bien plus rude et désagréable. Il donne aussi mieux que la palpation une idée de la réduction du passage du pharynx nasal causée par la végétation adénoïde.

Si possible, l'examen radiologique doit selon mon opinion toujours être fait s'il y a lieu de soupçonner des végétations adénoïdes dans les cas, où la paroi postérieure du pharynx nasal pour une raison quelconque ne peut pas être inspectée avec l'aide de la rhinoscopie antérieure.

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A NEW PROJECTION FOR THE ROENTGENOLOGY OF THE OPTIC FORAMEN¹

by

Joh. Frimann-Dahl, M. D.

(Tabula LXIV)

The roentgenology of the optic foramen is as a rule a complicated task, offering considerable difficulties. To secure first-rate pictures, it is often necessary to make several exposures. A number of different articles on the technique for the roentgenology of the optic foramen have from time to time been published. Most of the methods discussed, however, are complicated, besides frequently requiring special apparatus.

In his treatise on «The Apparatus and Technique for Roentgen Examination of the Skull», E. LYSHOLM writes as follows:

»The optic foramen should 'if possible' appear near the middle of the orbit.» I have taken the liberty of supplying the words »if possible» with quotation marks, in order to show that the difficulties in this case are well-known.

The technique to be discussed below has two advantages: in the first place, it is simple and easy for both patient and operator; secondly, it renders rapid and accurate results in practically all cases.

Differing from all former methods employed, the patient lies on his back (occiput), a position offering many advantages. First of all, it is easier for the patient to remain quiet during exposure. In many cases, namely, it is extremely difficult for patients who, for example, suffer from a cerebral tumour, to lie quietly in a ventral (frontal) position. Secondly, because the eye is not hidden by the plate, the centering is far easier. Owing to the longer distance between object and film, the foramen appears somewhat enlarged. The use of a fine focal tube (not over 2 kw), however, now commonly employed in the roentgenography of the skull, renders the indistinctness due to distortion (the long distance between object and film) almost negligible.

¹ Submitted for publication July 13th, 1933.

The orbit is sphenoid with the optic foramen situated about at the apex of the wedge. The axis passing through the central plane of the orbit forms an angle of 30 degrees with the sagittal plane. Owing to this fact, the patient's head is turned to the side at an angle of 30 degrees. If the *right* side of the optic foramen is to be photographed, the head is turned to the *left*, if the *left* side is to be photographed, the head is turned to the *right* — in both cases at an angle of 30 degrees. (Fig.)



Fig. I.

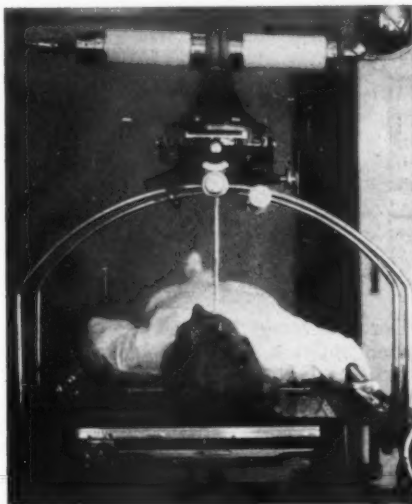


Fig. II.

The central ray is then centered on the middle of the eye's pupil, on the respective side to be photographed. Fig. I. The tube is placed in the center of the table and *does not need to be moved* during the process. Fig. II.

In this picture LYSHOLM's skull-table with secondary diaphragms has been used. Any roentgen table may, however, be employed, provided a fine focal tube (less than a 2 kw. tube) is disposable.

In the Roentgen Department of the 'Rikshospital' (State Hospital), this method has of late been employed and, in almost all cases, good results have been registered.

Fig. III and Fig. IV show a normal optic foramen taken according to the method described above. The optic foramen is projected directly upwards and medially to the fissura orbitalis superior. The outlines are distinct and even, the shape round or somewhat oval.

Fig. V shows an advanced destruction of the optic foramen with an opening into the fissura orbitalis superior.

The roentgen picture of the skull shows, moreover, distinct symptoms of increased intracranial pressure (hydrocephalus internus) with a violent sutural disruption and an enormous enlargement of the sella turcica (pressure-sella).

If desired, stereoscopic pictures can be taken; as a rule, however, an average roentgen photogram is just as satisfactory.

SUMMARY

A new method for taking roentgen pictures of the optic foramen is presented, offering the following advantages:

It is simple, rapid and accurate, requires no special apparatus and eliminates any adjustment of the tube.

The paper is supplied with photographs showing the method at work, as well as with pictures of a normal optic foramen and of an advanced destruction of the optic foramen, due to increased intracranial pressure.

ZUSAMMENFASSUNG

Der Verf. legt eine neue Methode zur Aufnahme von Röntgenbildern des Foramen opticum vor, die folgende Vorteile bietet.

Sie ist einfach, rasch ausführbar und genau, erfordert keinen besonderen Apparat und macht jede Adjustierung der Röhre überflüssig.

Der Aufsatz ist mit Photographien versehen, die die Arbeitsmethode zeigen, und mit Abbildungen eines normalen Foramen opticum und einer fortgeschrittenen Zerstörung des Foramen opt. infolge von Erhöhung des intrakranialen Druckes.

RÉSUMÉ

Présentation d'une nouvelle méthode de radiographie du trou optique, présentant les avantages suivants:

Simplicité, rapidité et exactitude; point d'appareil spécial et élimination de toute mise au point de l'ampoule.

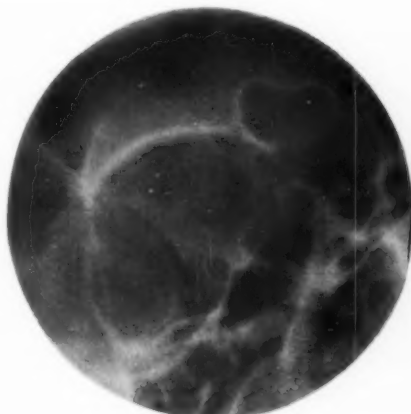
A la communication sont annexées des photographies représentant l'application de la méthode, tant à des trous optiques normaux qu'à des trous optiques en état de destruction avancée par suite d'hypertension intra-cérébrale.

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Fig. IV.



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Fig. III.



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Fig. VI.

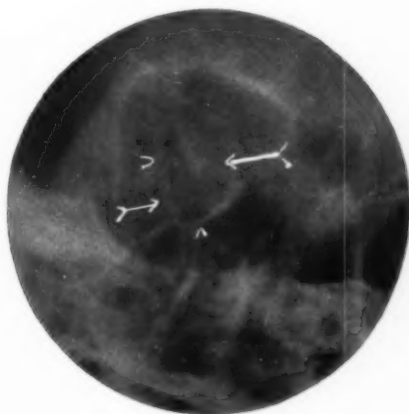
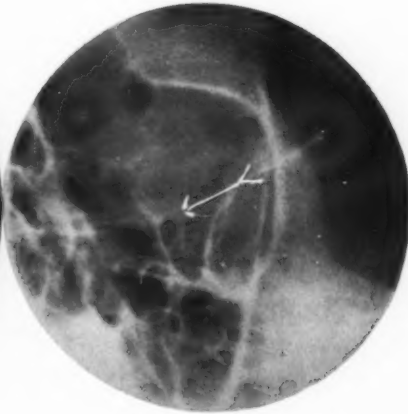


Fig. V.



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TREATMENT OF MALIGNANT MELANOMAS OF THE SKIN AND VULVA AT THE RADIUMHEMMET, STOCKHOLM¹

by

Isabel M. Scharnagel, M. D., New York City

(Tabulae LXV—LXVI)

The origin of malignant melanomas is the subject of much investigation in the scientific world at present, while comparatively little is done with regard to their treatment. EWING writes: »The peculiar and obscure conditions of its origin, the remarkable physiological properties of the chromatophores in the animal kingdom, the eccentricities of its clinical course and its interesting history as a field of debate render this tumor (melanoma) one of the most notable topics in oncology.»

The treatment of malignant melanomas has always been considered practically hopeless. During the two decades following the introduction of radiation therapy, it was not applied to these tumors, although the results from surgery were recognized to be very poor. In the past two decades, however, radiation has been combined with surgery and, in spite of the fact that this tumor is believed to be radio-resistant, the results seem to have been improved. This encouraged some clinics to attempt treatment with radiation as the single agent in the past few years. No conclusive results can be cited at present.

During eight months study and observation of the organization and principles and methods of treatment at the Radiumhemmet², I have very kindly been allowed to make a survey of the cases with this tumor. Between Jan. 1, 1921, and July 1, 1930, there were examined at the Radiumhemmet eighty-one patients who had malignant naevus cell tumors of the skin and vulva. Tumors of the eye were not included in this report. Eleven of the patients with these tumors who were examined were not treated, either because of the advanced stage of the disease or because they were referred to the Radiumhemmet only for consultation.

¹ Submitted for publication July 31st, 1933.

² MARY PUTNAM-JACOBI Fellow 1932 to 1933.

Of the seventy patients who were treated, all except six had a histological diagnosis by a competent pathologist of melanosarcoma, melanocarcinoma, malignant melanotic tumor or malignant naevus cell tumor with or without pigmentation. The last terminology was favored by the pathologist, O. REUTERWALL, at the Radiumhemmet. All of the six unverified cases died of the disease. Only one lived more than two years and she had a typical history and a rapidly growing recurrent tumor at the time of admission. Five of the eleven untreated cases had a pathologically verified diagnosis. In computing the percentage of cures for various periods these were all considered as having died of the tumor in less than three years.

Etiological Factors. The commonly accepted theory of the origin of malignant naevus cell tumors from preexisting skin lesions was well supported by the histories of these patients. Of the eighty-one patients here considered, twenty-two said that a birthmark had been the first symptom and, of three whose first symptoms were from metastatic nodules, two said that a birthmark had been present at the site where the primary lesion was eventually discovered. This total of twenty-four patients with birthmarks which became malignant melanomas was almost 30 per cent. of the entire group. There were also many patients (thirty-six patients or 44 per cent. of the group) who had noticed a lesion for several or many years which had started to grow. Twenty patients (25 per cent.) had lesions of short duration which they described as a nodule or lump in the skin. The one remaining patient had a large tumor mass in the cervical region which was diagnosed only pathologically after a biopsy was made and for which no primary lesion was ever found. All the malignant melanomas of the vulva described in this series had caused symptoms for a short period only.

BRODERS and MACCARTHY reported seventy cases of malignant naevus cell tumors of which thirty-five had a history of previously noted birthmarks. Of COLEY and HOGUET's eighty-one cases, thirty-six had a similar history. GLEAVE, however, in a report of forty cases said that only eight remembered a congenital naevus at the same spot. (Eighteen of his cases had the tumors in the eye, however.)

The influence of trauma was not so well verified in any large groups of cases. Eleven patients at the Radiumhemmet (13.5 per cent.) gave a definite history of trauma at the time that the tumors began to grow. Seventeen patients had lesions on the foot and, whether trauma was mentioned or not (usually not), there was frequently some chronic irritant. Trauma, as an etiological factor, was pointed out by MARTY, GLEAVE, OWEN, and HOLFELDER, who thought subungual melanotic tumors were of traumatic origin. ADAIR and PACK commented that more women had subungual malignant melanomas than men, and yet they had less

trauma to their fingers in the average scheme of existence. No cases with tumors in this location were found in this series. BRODERS and MACCARTHY stated: »From a prophylactic standpoint, pigmented areas of skin, such as warts and naevi, should be removed when these are in locations which are or have been subjected to injury».

Age and Sex Incidence. Twenty-nine of the patients in this group (36 per cent.) were male and fifty-two (64 per cent.) were female. This series shows a higher percentage of females than others have: COLEY and HOGUET reported 56 per cent. females (fifty-one of ninety-one cases); GLEAVE 50 per cent. (twenty females among forty patients); ADAIR and PACK 53 per cent. (one hundred and ten of a total number of two hundred and five). However, of the patients with subungual melanomas two-thirds were female.

The average age at the time of admission of patients treated at the Radiumhemmet was 54 years. This may be compared with other investigators also: BRODERS and MACCARTHY gave the average age as 49 years; COLEY and HOGUET, 36.8 years; GLEAVE, 56.3 years; ADAIR and PACK, 45.5 years (in the 205 cases).

The frequency in the different decades of life may be seen in Table 1.

Table 1.

Age in Years	No. Cases	Per Cent.
0-19	3	3.8
20-29	8	10.1
30-39	5	6.3
40-49	10	12.7
50-59	14	17.7
60-69	24	30.4
70-79	12	15.2
80-89	3	3.8

Age incidence of seventy-nine cases.

Patients less than twenty years of age have not been reported before except by ADAIR and PACK who found 3 per cent. under twenty in the large group of cases at Memorial Hospital. The large number of patients over seventy years of age was noteworthy. One was reminded in this connection that the Swedish nation as a whole is noted for longevity.

Site of Malignant Naevus Cell Tumors. Various reports seemed to check rather well as regards the location of these lesions of the skin. The foot and leg were affected most frequently, in this series about one third of the tumors having these locations, and the feet were the seat

of two-thirds of this number. Lesions of the head and trunk (each taken collectively) were about equal in spite of the great disproportion in area of skin included.

Table 2.

Site of Tumor	No. Cases	Per Cent.
Head	18	22.8
Trunk	20	24.7
Feet	17	21.0
Legs	9	11.2
Vulva	5	6.2
Hands	3	3.7
Arms	2	2.4
Neck	5	6.1
Groins	2	2.4
Total	81	100.0

Site of cutaneous malignant naevus cell tumors.

Other Clinical Features. The clinical diagnosis of malignant melanomas was simple in a large percentage of cases. The history was often typical and the appearance of the lesion suggested its melanotic character. If there was no pigmentation, the differential diagnosis from skin carcinomas and angiofibromas of the skin was difficult, especially if the tumor was small. The differentiation of benign naevi from those in which there was malignant degeneration was often difficult. A history of rapid growth, increase in amount of pigment, ulceration and bleeding seemed to be the only points which aided.

Of thirty primary tumors seen and treated at the Radiumhemmet, twenty were less than three cm. in diameter, seven were three to five cm. and three greater than five cm. Five of these lesions had ulcerated spontaneously and four of the ulcerated ones were less than three cm. in diameter. Six of the primary tumors looked dark red and did not appear pigmented.

Thirty-six of the patients treated at the Radiumhemmet had metastases at the time of admission or at the time of operation if performed before admission. Three of this number had distant metastases in addition to those in the regional lymph nodes. It was impossible in one-third of the cases to tell how long a period elapsed from the first symptom which the malignant tumor caused until metastases appeared. In all other cases except four this period was less than a year, the shortest time being about one month or less and the longest four years. One patient

developed pulmonary metastases within half a year after the first symptom was noted but the others with such metastases did not develop them until two to four years later. One patient had widespread extension of the tumor in the skin with multiple nodules one half year after the first symptom.

The remaining thirty-four treated patients had no demonstrable metastases at the time of the first examination at the Radiumhemmet and twenty did not develop any before July 1, 1933. Six patients had their first metastases in the regional lymph nodes and these developed from four months to more than nine years after the first symptom of malignant change. Six others had metastases in the liver, lungs or brain first and these were noted at periods varying from one year and three months to ten years after the first symptom. The two remaining cases were not seen after the tumor metastasized and became fatal.

In spite of the fact that the primary tumors, as observed at the first examination, were not so varied in appearance, there was a striking variation in subsequent course. EWING described these «eccentricities in clinical course». Citation of one case report will illustrate the most benign type of lesion:

M. H., female, was admitted to the Radiumhemmet in 1923 at the age of 36. A birthmark on her cheek had begun to grow twenty years before and was excised by Professor BERG in 1903. The pathological report was melanosaarcoma. Several small dark growths soon appeared in and around the scar, which were treated with radium without visible effect. Roentgen rays were, also, ineffective so the lesions were excised with actual cautery. This was repeated many times in the years preceding her admission to the Radiumhemmet, at which time she had five or six small blue-black subcutaneous lesions on the right cheek but no metastases in the cervical lymph nodes.

Course at the Radiumhemmet: The nodules were excised with electroendotherapy, as well as subsequent ones two months and three years later. One in 1924 disappeared after the application of radium on the surface only. The patient had no recurrences after 1929 and was living and well in June, 1933.

The more malignant type of lesion, after the same treatment by excision, had a tendency to recur and become widely disseminated very quickly.

A. B., female, aged 60 years, when examined by Dr. BERVEN on April 25, 1928, had a melanoma 2 cm. in diameter on the right ear but no palpable metastases. The first preoperative treatment with Roentgen rays was given the same day and continued daily. On the third day following admission, the tumor was excised widely with electroendotherapy. Roentgen therapy was continued until 6 times $\frac{1}{4}$ H. E. D. was given with 40 cm. skin-target distance and 0.5 mm. Cu + 1 mm. Al filtration, to a field which included the ear, pre- and post-auricular regions and the cervical lymph nodes on the right side.

Five months later 5 times $\frac{1}{4}$ H. E. D. were given with the same technique. Three days after this was concluded a recurrence appeared which was electrocoagulated the same day. Rapid generalization of the disease caused death on January 27, 1929, only nine months after admission. Pathological reports on both the primary and the recurrent tumors were melanosaarcoma.

It would be desirable, in reviewing a group of cases, to be able to point to certain clinical features upon which one may base a prognosis, and a careful scrutiny of this material has been made with this end in view. For example, pigmentation of the primary tumor, early ulceration and multiplicity of tumors in the same patient were studied, but because of the small numbers the conclusions were not considered of any significance. The most important prognostic fact seemed to be the rate of growth as determined from the history. This must be considered of doubtful value, however, because of the large percentage of cases in which there was a benign lesion of long duration which had slowly begun to grow. The patients were always very vague about the length of time during which this growth had occurred and, in more than half of the cases, the primary lesion had been excised before admission, so its size could only be estimated from the patient's report.

Treatment of Malignant Melanomas'

Review of the Literature. The earliest treatment for these tumors was radical surgery. In 1916 BRODERS and MACCARTHY advised early diagnosis followed by radical removal of both the primary growth and the regional lymph nodes. Of the seventy cases reported, four had tumors of the eye and it is now generally recognized that eye cases have a better prognosis than those with lesions of the skin. Thirty-eight of the patients were operated upon within a period of ten years and traced after the operation. The mortality at the end of this period was 86.8 per cent. and only 5.2 per cent. of the dead patients had lived four to eight years after the last operation. Of the five patients who were living, two had their last operation three years before. These authors gave as the average duration of life after the last operation eleven months and three days. The necessity of early dissection of the regional lymph nodes was, also, stressed by GLEAVE in 1929. Reporting twenty-two cases with lesions of the skin, he found that the total duration of the disease from the onset of malignant changes, as evidenced by increased pigmentation, increased growth or ulceration of a mole, was two years and ten months. He cited one case, however, of a patient who survived ten years after removal of nodes invaded by the tumor. BLOODGOOD (1922) said that of two hundred malignant moles operated on in thirty years with the knife or cautery, only one was cured for five years.

Another article published in 1916, that of COLEY and HOGUET advocated combined treatment of the tumors under discussion. It contained reports of eighty-one cases (eleven in the eye) which were treated with surgery, irradiation and toxins. Sixteen of these lived three years and of

six, who lived five years, only two had a pathological diagnosis of melanoma, the other four having none.

GOFORTH in 1926 reported three cases of malignant melanoma of the vulva. He expressed the belief that it was a preventable disease and that »postoperative irradiation proved of little or no value in arresting the progress of the disease in one of the cases». That patient, however, lived nine years and a half after four operations and irradiation. His other operable case was well seven years and a half after radical excision of the tumor and inguinal lymph nodes.

ARZT and FUHS in 1925 favored surgery as the first procedure in every operable case and radiation therapy only after that. WERNER expressed the same opinion in a book published during the same year but went a bit further by stating that the method of choice was a combination of surgery and radiation therapy. BÉRARD (1927) reported the treatment and results obtained in four cases of malignant melanotic tumors in a period of five years. One patient lived and was well for five years. He urged a combination of surgical and radiotherapeutic procedures, especially favoring the surface application of radium. He subjected the lymph nodes to both radium and Roentgen radiation.

Not until the past five years have authors dared to advocate irradiation as the sole therapeutic agent for malignant naevus cell tumors. Occasional cases, so treated, were reported before. In 1924 OWEN reported a case who had refused the surgical procedure advised and who was living and well three years after Roentgen treatment was instituted. RATERA and RATERA in 1926 reported a case living and well over four years after treatment with Roentgen rays and radium. JEANNENEY and MATHEY-CORNAT (1927) had one patient free from signs and symptoms of tumor three years in a series of three which were treated with deep Roentgen therapy. In one case reported by MARTY (1928) the primary tumor and swelling from metastases in the lymph nodes were made to disappear by the use of irradiation (Roentgen rays and radium). But one year and a half later, there was a recurrence and metastases were again demonstrable. Radical dissection at this time was followed by generalized disease in a few months.

MIESCHER (1926) in discussing radio-resistance of melanomas cited three cases (not controlled more than about a year) which supported his belief that the different parts of these tumors varied in radiosensitivity. BURNAM (1933) stated that »very few melanoepitheliomas are cured by local removal, on account of early metastases», therefore, the addition of radiation might add to the possible results as some of these tumors were »moderately ray-sensitive». F. C. WOOD, however, wrote that »the melanomata are but little affected by the most intensive radiation».

Surgery was condemned as a dangerous procedure by HOLFELDER in an article published in 1929 in which he reported eighteen cases which were treated, he said, with energetic radiation with Roentgen rays but fourteen of which had also had operations. The average length of life for these patients was a little more than two years. MCEUEN in 1930 reported six cases treated with Roentgen rays (technique given in detail) and two of them were well more than five years.

EVANS and LEUCUTIA (1931) in an article on treatment of pigmented moles and malignant melanomas said that »Roentgen therapy is the treatment of choice» using »hypermassive» doses. Their cases were divided into three clinical groups. The first group consisted of patients with tumors less than five cm. in diameter and two cm. elevation without metastases. Twenty-one such cases, treated with hypermassive doses of soft unfiltered Roentgen rays and prophylactic deep radiation to the regional lymph nodes in clinically malignant cases, had no recurrences or metastases within two to five years. There was no microscopic report on any of this group. The second group contained cases with large primary tumors with or without metastases, as well as those with small tumors which had metastasized. There were two methods of treatment used for these cases. Massive radiation was advised first and, if not effective, surgery later. Of five patients in this group, two (histologically verified) were well for five years. Dissection of metastases in the regional lymph nodes was followed by Roentgen radiation. The third group included cases with extensive lymphatic, cutaneous and visceral metastases and of twenty-five which were treated, three lived more than four years. These three, also, were histologically diagnosed.

Radiumhemmet's material came in the period of combined therapy chronologically. This method was the one of choice at that time and has continued to be, although some cases reported here were treated radiologically only.

Technique at the Radiumhemmet in General: The cases included in this report cover a long period of time (almost ten years) and, since there have been such poor results generally in these tumors, all possible combinations have been attempted.

The technique and principles of electroendothermy used at the Radiumhemmet have been described by BERVEN. For malignant naevus cell tumors, the usual method has been what he terms »electrotomy», or excision with the knife electrode. In many cases after the tumor was removed the base and margins of the wound were coagulated with a flat round electrode and the wound left open for spontaneous sloughing and secondary healing. If ulcerated or infected, the tumor was coagulated primarily between two active flat electrodes and then excised to avoid spreading the infective organisms. The usual practice in electro-

tomy was to excise one to one and a half centimeters of normal skin outside the tumor margin. All vulva tumors were coagulated between two electrodes according to BERVEN's special technique.

The Roentgen treatment was all given according to the simple fractional method (SCHINZ). Running conditions were 160 to 190 Kv and 6 ma. The filtration was 0.5 mm. Cu + 1 mm. Al until 1928. Since this time THORÆUS' tin filter, qualitatively equivalent with 2.1 mm. Cu + 1 mm. Al, has been used in most of the cases as it seems especially adapted for deeply seated tumors, such as metastatic nodules. Treatments were given daily in doses of 25 to 50 per cent. of one H. E. D. The total dose to each field has been, as a rule, one to one and a half H. E. D. In recent years this has been markedly increased according to the modern principles. The H. E. D. unit used at the Radiumhemmet is about 900 r with THORÆUS' tin filter, when measured without secondary radiation. Similarly measured with a filter of 0.5 mm. Cu + 1 mm. Al the unit is 725 r.

Teleradium treatment was, after 1922, given with LYSHOLM's apparatus containing one to two grams of radium element with a radium-skin distance of three or five cm. and filtration equivalent to four mm. lead. Since 1930 the apparatus constructed by SIEVERT was used, also. It contained three grams of radium, had six mm. lead filter and the radium skin distance was six cm. To a small primary tumor which could be irradiated with one field at three cm. distance, the dosage was 20,000 mg. hr., this being an epidermicidal dose. The same reaction was produced in the skin with about 34,000 mg. hr. at five cm. and 40,000 mg. hr. at six cm. When more than one field was required, because of the size or location of the tumor, these were directed so as to obtain a crossfiring effect to the tumor. The dose to each field had then to be considerably less because of overlapping. Treatment was usually given for two hours daily, in that way the total dose required one to three week's time.

Surface applications of radium were made occasionally to malignant melanomas. These were done with the aid of dental plastic mass, the tubes containing five or ten mg. Ra element with filtration equivalent to two or three mm. lead and the radium-skin distance being one-half to one cm. With this technique an epidermicidal dose was obtained in twenty to forty hours.

After surgical procedures, especially dissection of metastatic nodules, radium was inserted into the wound either immediately or within a few days. This radium was in the form either of needles or tubes. The tubes contained twenty-five mg. radium element and were two or three cm. long. Two to six were used depending upon the size of the defect. The filtration was two to three mm. lead and an extra distance of two or three

mm. was added with dental compound. The tubes were left in situ for ten to twenty hours.

By principle, melanotic tumors were not treated with intratumoral irradiation, because of the danger of spreading the tumor cells. This method was used in one case where the diagnosis was not clear, as biopsies of skin tumors were not made at the Radiumhemmet until treatment was started. Intubation with needles was used, by intention, however, to obtain irradiation of the adjacent tissues after surgical excision of metastases. The needles commonly used contained ten mg. radium, had an effective length of one cm. and a diameter of two and one-fifth mm., with platinum and gold filtration equivalent to almost one mm. lead. They were placed parallel with approximately seven mm. distance between and left in situ three to five hours.

In the group of seventy cases treated by these methods, in general, four had electroendothermy only, thirty-eight had electroendothermy combined with irradiation, and twenty-one had irradiation only. Seven cases were treated prophylactically with irradiation only. The cases which received irradiation only were very advanced and unfavorable, consequently this treatment was given as a palliative measure. All except four of these patients had recurrent inoperable tumors and there were only five which did not have metastases in the regional lymph nodes while two had distant metastases at the time of admission.

Results Obtained at the Radiumhemmet

The total number of cases admitted was eighty-one and seventy were accepted for treatment. Patients considered for ten-year results were those examined between January 1, 1921, and July 1, 1923. There were eighteen of these and one was not treated. For five-year results were considered, in addition, patients who applied for examination up to July 1, 1928. Seven of the fifty-six in this group were not accepted for treatment. For all seventy cases there were three-year results as all were admitted before July 1, 1930 and all living patients were followed until July 1, 1933.

The mortality was 71.6 per cent. at that time, all untreated cases being considered dead. Twenty-three patients were living, fourteen of these having been observed over a period of five years and five over a period of ten years. Four patients died of intercurrent diseases: one during the first year after admission; two before the end of three years and one more than ten years after admission at the age of 86. The average length of life of dead patients, counting from the first operation or from admission, was about one year and eleven months.

By the rate of «absolute» cure in Table 3 was meant the number of cases that were alive and free from signs and symptoms of disease three, five, and ten years respectively, after operation (if operated upon first at the Radiumhemmet) or after admission (if operated upon before admission) in proportion to the total number of patients *who applied to the clinic for treatment*. It was 39.5 per cent. for three years, 33.9 per cent. for five years, and 33 per cent. for ten years. The rate of «actual» cure was the number that was living and well for a given period of time in proportion to the number of cases *treated*. This rate was 45.7 per cent. for three years, 38.7 per cent. for five years and 35 per cent. for the ten-year period. (I have used the term «rate of actual cure» with the same meaning as the «relative Heilung» of the German literature.)

Table 3.

	Three Years		Five Years		Ten Years	
	No. Cases	Living and Well	No. Cases	Living and Well	No. Cases	Living and Well
»Absolute» Figures . . .	81	32 (39.5 %)	56	19 (33.9 %)	18	6 (33 %)
»Actual» Figures	70	32 (45.7 %)	49	19 (38.7 %)	17	6 (35 %)

Rate of cure for three, five and ten-year periods.

The variation in the percentage of cure for the different time periods was relatively small. FORSELL showed that the permanency of healing after radiological treatment only was at least as good as after surgery. The majority of these so-called «cured patients» had both surgical and radiological treatment and the results seemed to indicate a permanent healing to about the same degree as after radiological treatment alone.

The rate of cure for one year could not be calculated in exactly the same manner because, in the same group of cases, all patients who lived less than three years after operation or admission were dead before July 1, 1933. These figures are, therefore, not included in Table 3. They are cited here, however, in order to study the cause of death in the second and third years. Of the seventy cases treated forty-eight were living and well for one year. Calculating the percentages as was done in Table 3, the «absolute» cure rate was 59 per cent. and the «actual» cure rate was 68 per cent. for a one-year period.

Of the sixteen patients who died in the second and third years after admission, two died of intercurrent diseases. Eight died of metastatic growths, having no signs of recurrence at the site of the malignant melanoma. Four patients had recurrences at the site of the primary tumor and metastases before death, which occurred in the second year. One patient,

whose primary lesion was on the temple, died of cerebral metastases without local recurrence, while another patient had a tumor in the same location which grew by extension, causing death before it metastasized.

Thirteen patients included in the number living and well for three years are not included in the five-year period. Nine of these were living and well July 1, 1933. The four, who died during the fourth and fifth years after admission, had generalized metastases but only one had a local recurrence and her tumor was in the temporal region.

As mentioned before, the lower extremities were the predominant site of malignant naevus cell tumors and from Table 4 it seemed that the results in this region might have been slightly better. It must be remembered, however, that the possibility for radical surgery was greater. There were only three tumors on the hands and two on the arms. Two tumors, said to be in the groin, were really in the skin of the inguinal region and were primary tumors.

Table 4.

Site of Tumor	Three Years		Five Years	
	No. Cases	Living and Well	No. Cases	Living and Well
Extremities	25	14	20	10
Head and Neck	21	9	17	5
Trunk and Groin	20	8	10	4
Vulva	4	1	2	0

Distribution of malignant melanomas with three and five year results.

Only in the cases which were treated primarily at the Radiumhemmet was the size of the tumor definitely known. These thirty primary tumors only were used for Table 5. As could be expected, the five year results seemed to be better in cases with small tumors. Eight of these twenty patients had metastases at the time of admission, one of the seven patients with tumors three to five cm. in diameter had metastases and all three with large tumors had metastases in the regional lymph nodes at the time of first examination.

Table 5.

Size of Tumor (Dia. in cm.)	Three Years		Five Years	
	No. Cases	Living and Well	No. Cases	Living and Well
Less than 3	20	9	11	6
3 to 5	7	4	5	1
More than 5	3	2	2	0

Size of primary tumors and rate of cure.

Thirty-six of the seventy patients treated had metastases in the regional lymph nodes at the time of first examination at the Radiumhemmet. Three patients had distant metastases also, two pulmonary and one had widely disseminated skin nodules.

Table 6.

Metastases in reg. lymph. nodes	Three Years		Five Years	
	No. Cases	Living and Well	No. Cases	Living and Well
Present	36	9	25	4
Absent	34	23	24	15

Results in cases with and without metastases at admission.

Seven of the thirty-six patients who had metastases at the time of admission were living and well July 1, 1933. This was 19 per cent. Among the thirty-four who did not have metastases, twenty did not develop any, although four died before the period when this report was ended. Three of these died of intercurrent diseases (one at the age of eighty-six) and one died with a recurrence in the scar with extension of the tumor locally.

Of the patients with metastases at the time of admission, twenty-four, with nodular involvement based upon clinical findings only, were treated with irradiation to these lesions, eleven cases had radiation therapy combined with dissection of the involved nodular areas, hence have pathological verification of the extension of the tumor. One patient discontinued her treatment before any was given to the metastatic lesions. One of the radiologically treated cases was living and well five years after treatment was begun, and three cases were well five years after combined treatment to the metastatic nodules.

Table 7.

Therapy	Three Years		Five Years	
	No. Cases	Living and Well	No. Cases	Living and Well
Radiation	24	3	14	1
Surg. and Rad.	11	6	9	3
None	1	0	0	0

Results after radiation only and after combined treatment to metastases in lymph nodes.

A similar grouping of all cases according to the treatment is seen in Table 8. Only the treatment carried out at the Radiumhemmet or surgical procedures advised there after admission were considered, with one exception. Seven patients were admitted for postoperative irradiation within a month after operation (the second one in three instances) having no signs of tumor either recurrent or metastatic. These cases were called prophylactic and were included in the group having combined treatment. One case, operated on before admission, who had a recurrence, received only radiation to the recurrent tumor at the Radiumhemmet but, since metastases in the regional lymph nodes were operated upon he was considered to have had combined treatment. For surgical procedures on metastases all the patients except one were referred to the surgical department of a general hospital. That one had the metastatic nodes in both axillae excised with the electric knife. All electroendothermy operations were performed at the Radiumhemmet. In five cases this was repeated for one or more recurrences.

Table 8.

Treatment	Three Years		Five Years	
	No. Cases	Living and Well	No. Cases	Living and Well
I. Electroendothermy only	4	4	4	4
II. Combined Treatment (Incl. Prophylactic) . .	45	27	29	14
III. Irradiation only	21	1	16	1

Three and five year results with three methods of treatment.

The five year results for cases treated only with electroendothermy are remarkable. Because of the small group, however, it is supposed that the cases happened to be prognostically favorable ones. Two of the tumors were recurrent but none had metastases at the time of admission. The report of one of the cases with a recurrent tumour has been given.

On the other hand, the poor results from radiation as the sole therapeutic agent seem partially due to the fact that all of the tumors treated, except four, were recurrent. One of the four primary tumors had metastasized to the regional lymph nodes before treatment was instituted. All the recurrent tumors except two had metastasized to the regional nodes and two were complicated by pulmonary metastases as well. The treatment in many cases was considered merely palliative. A photomicrograph of the tumor from the patient who lived and was well for five years may be seen in Plate II.

The specific treatment carried out in the individual cases with three year results may be seen in Table 9. Where electroendotherapy was repeated one or more times, only the irradiation given before and after the operation on the first lesion was mentioned here.

Table 9.

Treatment to Tumor and Regional Lymph Nodes	No. Cases	Three Years Living and Well
I. <i>Electroendotherapy to tumor only</i>	4	4
II. <i>Combined treatment</i>	—	—
Tumor: Electroendotherapy. Prophylactic Roentgen to lymph nodes	6	5
Tumor: Electroendotherapy. Metastases: Teleradium	3	0
Tumor: Electroendotherapy. Metastases: Roentgen rays	2	0
Tumor: Electroendotherapy. Pre- and Post-operative Radiation. Metastases: Roentgen rays	3	2
1. Preoperative Roentgen and Teleradium. Post-operative Radium in wound	—	(1)
2. Pre- and Post-operative Roentgen rays	—	(0)
3. Pre-operative Roentgen. Post-operative Radium in wound	—	(1)
Tumor: Pre-op. Radium surface app. Electroendotherapy. Post-op. Roentgen. No treatment of nodes	1	1
Tumor: Pre-op. Radiation. Electroendotherapy. Metastases: Roentgen rays	4	2
1. Pre-op. Roentgen and Teleradium	—	(1)
2. Pre-op. Radium surface application	—	(0)
3. Pre-op. Roentgen	—	(1)
4. Pre-op. Roentgen (discontinued very soon)	—	(0)
Tumor: Pre-op. Radiation. Electroendotherapy. No treatment of nodes	3	2
1. Pre-op. Radium surface application	—	(1)
2. Pre-op. Teleradium (Small dose)	—	(1)
3. Pre-op. Radium surface application	—	(0)
Tumor: Pre-op. Roentgen, Electroendotherapy. Metastases: Roentgen and Radium surface application	1	0
Tumor: Electroendotherapy, Post-op. Radiation. Metastases: Radiation	6	5
1. Post-op. Radium surface application. Nodes: Proph. Roentgen	—	(1)
2. Post-op. Roentgen. Nodes: Proph. Roentgen	—	(1)
3. Op. 3 times, Various forms post-op. radiation. Metastases: Roentgen	—	(1)
4. Post-op. Radium surface app. Nodes: Proph. Roentgen	—	(1)
5. Op. twice. Post-op. Teleradium. Nodes: Proph. Roentgen	—	(1)
6. Op. twice. Post-op. Radium surface application. Metastases: Roentgen and Teleradium	—	(0)
Tumor: Electroendotherapy. Metastases: Pre-op. Radiation, Surgery. Post-op. 1. Pre-op. Teleradium. Post-op. Intubation, Teleradium, and Roentgen	4	1
2. Pre- and Post-op. Roentgen	—	(0)
3. Pre-op. Roentgen. Post-op. Radium surface app.	—	(0)
4. Pre-op. Roentgen and Teleradium. Post-op. Intubation	—	(1)
Tumor: Electroendotherapy. Post-op. Roentgen. Metastases: Pre- and Post-op. Radiation, Surgery	2	0
1. Pre- and Post-op. Roentgen	—	—
2. Pre-op. Roentgen and Teleradium. Post-op. Intubation	—	—
Tumor: Electroendotherapy. Metastases: Surgery, Post-op. Radium in wound	1	1
Tumor: Electroendotherapy. Metastases: Pre-op. Roentgen, Operation	1	1
Tumor: Roentgen. Metastases: Pre- and Post-op. Roentgen, Operation	1	1

Treatment to Tumor and Regional Lymph Nodes	No. Cases	Three Years Living and Well
Prophylactic Cases.		
Tumor: Operation, Post-op. Teleradium. Nodes: No treatment	1	1
Tumor: Operation, Post-op. Teleradium. Nodes: Roentgen	2	2
Tumor: Operation, Post-op. Teleradium. Nodes: Teleradium	1	0
Tumor: Operation, Post-op. Intubation of radium. Nodes: Teleradium and Roentgen	1	1
Tumor: Operation, Post-op. Roentgen. Nodes: Roentgen	1	1
Tumor: Operation only. Nodes: Roentgen	1	1
III. Radiation Only		
Tumor: Teleradium and Radium surface app. Nodes: Roentgen	1	1
Tumor: Teleradium and Roentgen. Metastases: Roentgen	3	0
Tumor: Teleradium. Metastases: Teleradium	2	0
Tumor: Radium surface app. Metastases: Roentgen	3	0
Tumor: Roentgen and Radium surface app. Metastases: Roentgen	1	0
Tumor: Roentgen only. Metastases: Roentgen	6	0
Generalized Roentgen	1	0
Tumor: Intubation only (treatment interrupted)	1	0
Tumor: Teleradium	1	0
Tumor: Non-recurrent. Metastases: Teleradium	1	0
Tumor: Non-recurrent. Metastases: Roentgen	1	0

Conclusions

FORSSELL's principle, that radiation must not be given in such heavy doses as to disturb the natural resistance of the body to the malignant growth, has always been followed at the Radiumhemmet. Radioresistant tumors, therefore, are principally treated with a combination of radiation and surgery. For more than a decade malignant melanomas have been treated with electroendothermy combined with the various forms of radiation. The experience from treatment only with radiation in heavy doses is limited but it is known that such heavy radiation always is accompanied by a risk of late damage to the normal tissues. This risk is avoided when the combined treatment is used. The results from this treatment seem favorable when compared with the other results which have been published. The technique of radiation has been so varied in proportion to the number of cases that it is difficult to say which combination is the one of choice. It seems most favorable, however, to combine electroendothermy with both pre- and postoperative irradiation as this has proved valuable in other tumors as well, especially mammary carcinoma.

The results here published also prove that the prognosis is not absolutely bad even in cases with invasion of the regional lymph nodes by the tumor. The fact that three patients are living and well five years

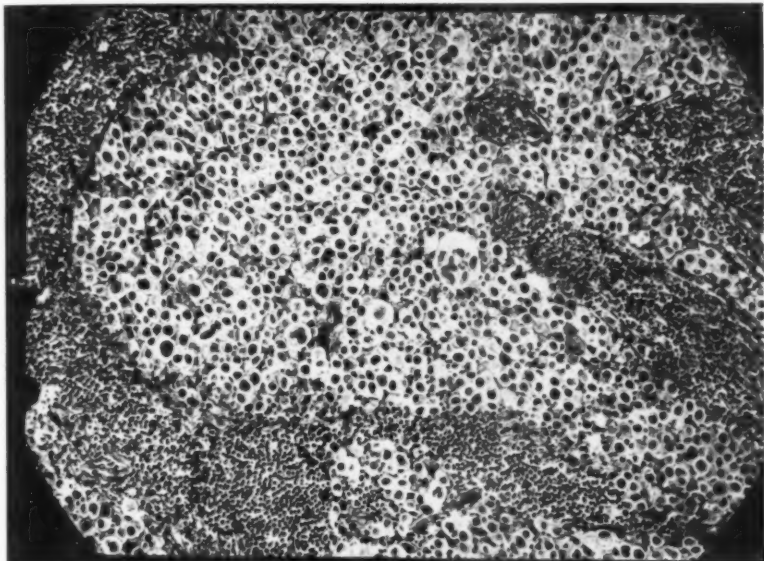


Plate I. Metastatic growth in supraclavicular lymph node from a malignant melanoma of the skin of the shoulder. Patient living and well ten years and five months after excision of this node and radiation.

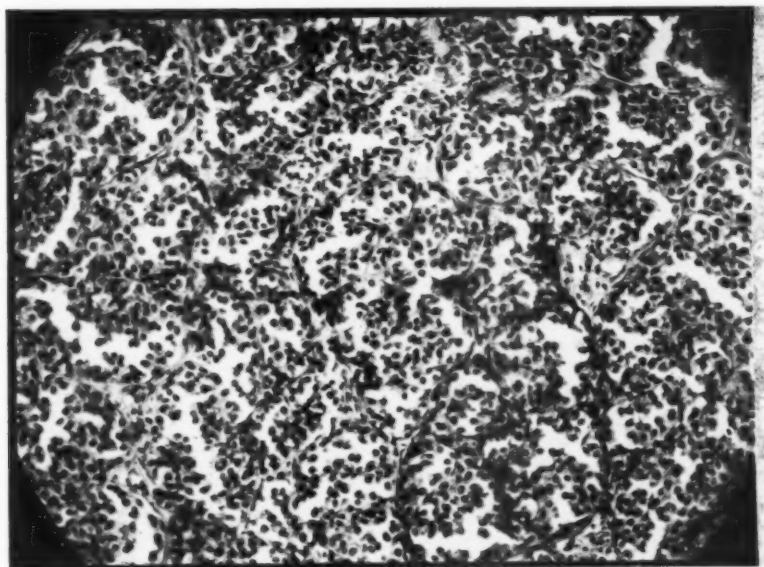


Plate II. Biopsy from malignant melanoma of the skin of the foot, 5 cm. in dia. Patient living and well five years and a half after radiological therapy only.



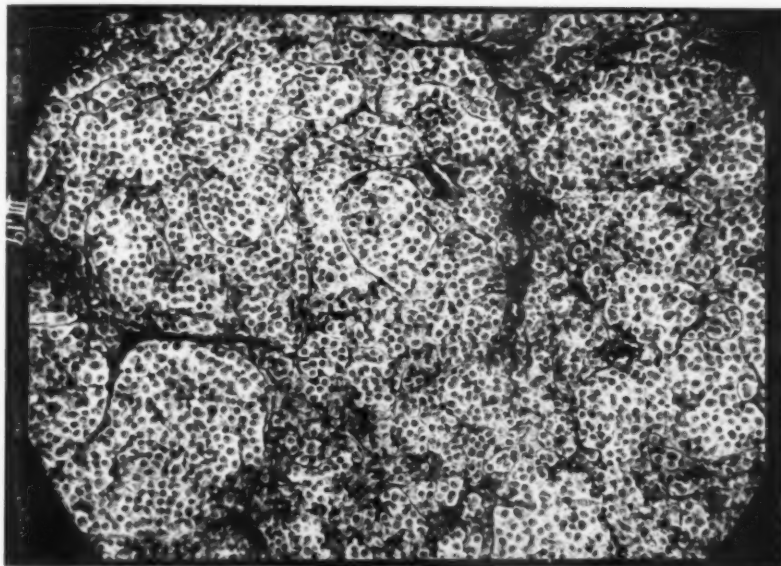


Plate III. Malignant naevus cell tumor from the skin of the ankle. Patient living and well nine years and eight months after electroendothermy excision and postoperative irradiation.

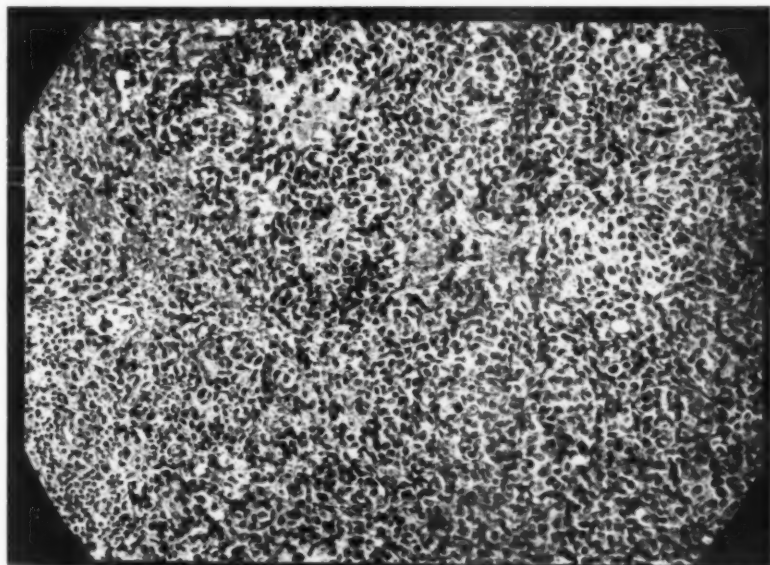


Plate IV. Malignant melanotic tumor of the skin of the right breast excised with electroendothermy. Patient living and well eleven years and four months later.



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after the dissection and radiation of these nodes must encourage the use of such treatment when metastases are demonstrable.

SUMMARY

A brief survey has been made of the literature which describes methods and results of treatment of malignant melanomas of the skin. All cases with these tumors treated at Radiumhemmet between Jan. 1, 1921 and July 1, 1930 (seventy in number) are reported. Malignant melanoma has been diagnosed histologically in all cases except six, all of whom died of the disease. Three cases had distant metastases at the time of admission and thirty-three others had metastases in the regional lymph nodes.

Electroendothermy in combination with radiation was the treatment in forty-five cases. Four were treated with electroendothermy only and twenty-one only with radiation. The latter had inoperable or advanced lesions. The rate of cure based on the seventy cases for three years was 45.7 per cent. For five years the rate was 38.7 per cent. based on forty-nine cases and the ten year rate for seventeen cases was 35 per cent.

It is concluded that the treatment of choice is the combined method and that operable metastases should be treated with dissection in combination with radiation.

ZUSAMMENFASSUNG

Verf. gibt einen kurzen Überblick der Literatur über die Methoden und Resultate der Behandlung von malignen Hautmelanomen und teilt alle Fälle solcher Tumoren mit (70 an der Zahl), die in der Zeit vom 1. Januar 1921 bis 1. Juli 1930 am Radiumhemmet behandelt wurden. Die Diagnose Malignes Melanom war in allen Fällen mit Ausnahme von sechs histologisch begründet, und alle diese erlagen ihrem Leiden. Drei Fälle hatten bei der Aufnahme Fernmetastasen, und dreiunddreissig von den anderen hatten Metastasen in den regionären Lymphdrüsen.

Die Behandlung bestand bei 45 Fällen in einer Kombination von Elektroendothermie mit Bestrahlung, bei vier Fällen nur in Elektroendothermie und bei einundzwanzig nur in Bestrahlung. Die letzteren hatten inoperable oder vorgeschrittene Geschwülste gehabt. Drei-Jahres-Heilung war bei 45.7 % von allen siebzig Fällen, 5-Jahres-Heilung bei 38.7 % von 49 Fällen und 10-Jahres-Heilung bei 35 % von 17 Fällen zu konstatieren.

Verf. zieht den Schluss, dass als Behandlung der Wahl die kombinierte Methode zu gelten habe, und dass operable Metastasen durch Exzision in Kombination mit Bestrahlung behandelt werden sollen.

RÉSUMÉ

L'auteur donne un cours aperçu de la littérature décrivant les méthodes et les résultats du traitement des mélanomes malins de la peau. Elle communique tous les cas traités au Radiumhemmet du 1 janvier 1921 au 1 juillet 1930 (70 en tout). Le diagnostic de mélanome malin a été établi par l'examen histologique dans tous les cas sauf six, qui tous ont succombé à l'affection. Trois malades

présentaient des métastases à distance au moment de leur admission et 33 autres des métastases des ganglions de la région.

Dans 45 cas, le traitement a consisté en électroendothermie combinée avec des irradiations. Quatre malades furent traités par l'électroendothermie seule et 21 par les irradiations seules. Ces derniers étaient porteurs de lésions inopérables ou avancées. La proportion de guérisons était, pour les 70 cas, de 45.7 % pour trois ans; pour cinq ans, elle était de 38.7 % sur 49 cas et, pour 10 ans, de 35 % sur 17 cas.

L'auteur conclut que le traitement de choix est la méthode combinée et que les métastases opérables doivent être traitées par la dissection combinée aux irradiations.

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GENERALISED XANTHOMATOSIS¹

by

O. K. Svenningsen

The mere occurrence of a case of some rare disease does not always justify its being signalised in the medical literature, much less so when its communication does not in any way help to facilitate the diagnosis and treatment of other, corresponding affections. If I nevertheless venture to call attention to the history, roentgenological picture and a number of clinical observations in connexion with the case reported below, it is in the first place because the disease in question is in itself extremely rare, so that a reminder of its existence may not be out of place, and secondly because no case of it has ever, so far as I can find, been described in Danish medical literature.

The disease figures in the literature chiefly under two names. In the earlier works of CHRISTIAN (1919), SCHUELLER (1921) and others it is called dyspituitarism; by ROWLAND (1928) and others it is termed xanthomatosis. The disease is the same, and is described also merely under the name of CHRISTIAN's syndrome, a triad made up of the symptoms diabetes insipidus, exophthalmus and defects in the cranial bones. In that form it was first described, in 1919, by H. A. CHRISTIAN.² The correct appellation is indisputably xanthomatosis; because ROWLAND has shown that the osseous changes in the cranial theca consist in compact granulations in the periosteum and dura mater, containing chiefly xanthoma cells, often fibrously degenerated. ROWLAND deals at length with this feature in his large monograph, published 1928,³ a work so thorough that it almost seems fundamental with regard to this very

¹ Submitted for publication June 14th 1933.

² CHRISTIAN, H. A.: Defects in membranous Bones, Exophthalmos and Diabetes insipidus (in: Contributions to Med. and Biological Research. New York 1919; vol. I, p. 390).

³ ROWLAND: Xanthomatosis and the reticulo-endothelial System (in: Arch. of internal Medicine vol. XLII, 1928, p. 611).

rare pathological complex. He thinks it doubtful whether the osseous changes observed in xanthomatosis can be regarded as a special group, nosologically; still it will undoubtedly, for practical reasons, be best to consider this symptom as one by itself, because precisely the osseous changes roentgenologically constitute the most reliable aid to the diagnosis.

Xanthoma is known chiefly as a skin disease characterised by the presence of yellowish spots or nodules in the skin. In RASCH's work on skin diseases, two principal forms are described: the common and the diabetic xanthoma (corresponding to Rowland's groups 1 and 5). Common for these and for the groups mentioned below is the presence of xanthoma cells in the defects and patches or nodules. A xanthoma cell is a large connective-tissue cell whose plasma, besides containing one or several nuclei, has become vacuolised and contains numerous granulae that stain black with osmic acid. In certain forms of the disease, these cells occur diffusely distributed through the various tissues of the body, in which case the condition is termed xanthomatosis. According to ROWLAND, it is possible to establish five groups:

1. Xanthoma palpebrarum and multiplex xanthoma.
2. Xanthomyeloma in the sheaths of the tendons.
3. Visceral and generalised xanthoma; hereunder included Christian's syndrome.
4. Pick-Niemann's disease (a rapidly devolving form, peculiar to early childhood).
5. Xanthoma diabeticorum.

So far as I can see from the literature to which I have had access, the most thorough studies of the disease seem to be those made by ROWLAND; but grouping of its various forms have been attempted also by other authors, for instance by ABRIKOSOF,¹ who distinguishes between xanthomatosis respectively of (1) the skin, (2) the viscera and (3) the bones. As regards the case to be reported here, the question of its classification is, for that matter, of little importance, as the interesting fact about it is the presence of Christian's syndrome. Besides, the study of xanthomatosis and the various affections of the bones arising from that disease is as yet in this infancy, and their many different manifestations yet insufficiently known.

The clinical picture of xanthomatosis — or dyspituitarism, or Christian's syndrome — is extremely variegated. In all the cases described, the age at which the disease occurred was between the first and seventh year of life. It seems to be met with more frequently in subjects of the

¹ Verhändl. deutsch. pathol. Gesellschaft vol. XXIII, 1928, p. 101.

male sex than in those of the female. The initial symptoms vary enormously; still, in by far the greatest number of cases, gingivitis and loose teeth appear to be its first manifestations, just as in the case which I am going to describe. In some cases exophthalmus, polyuria and polydipsia are mentioned as the earliest indications of the disease. If one examines the history of the various cases, one finds an utter absence of regularity in the sequence of the symptoms, and with the exception of Christian's syndrome none of them seem to be even fairly constantly present. Beside exophthalmus, defects in the cranial bones and diabetes insipidus, some of the most frequently mentioned are strabismus, arrested growth, gingivitis, loose teeth, deafness, otorrhea, pains in the head and back, xanthomatous skin eruptions, adiposogenital dystrophy, infantilism, hydrocephalus, yellow spots in the retina, neuritis of the optic nerve, tumors of the neck, pelvis and liver, icterus, difficult walk, changes in the hematic picture, hypercholesterolemia, etc. Common for all the cases are, on the other hand, the negativity both of Pirquet's and Wassermann's reaction, and a good preservation of the intellectual faculties.

The prognosis *quoad vitam* is stated to be grave, but not hopeless. One author, SCHUELLER,¹ has thus observed a case in which the patient reached the age of twenty years. Unfavorable for the prognosis are increasing anemia, dyspnea and intense pains in the bones. As regards complete restitution, the prognosis is bad. Diabetes insipidus, for instance, will never cease.

The history of the case which I have had occasion to observe is as follows.

The patient was a girl, four years old, born July 15th, 1928, the daughter of a railway porter. She had been born on time, by natural delivery, was nursed at the breast for six or seven months, and developed healthily and normally. When four months old she had whoopingcough, but otherwise she was in perfectly good health up to the age of eighteen months. By that time the parents noticed that her left eye was always watering. She was found to be suffering from dacryocystitis; a slitting of the lacrymal puncta was performed, and a Bowman's probe inserted in the duct. She was now again perfectly well for about four months, until the time when she began to cut her second upper premolars. As she was then fully two years old, there was no question of retarded dentition. It was now observed that as these teeth broke through the gum, the latter became red and swollen, and after a couple of weeks the premolars were all the time surrounded by a small accumulation of pus. For about three months she was treated for this at home, her mouth being constantly rinsed and the suppuration sponged up, which

¹ Klin. Wochenschr. 1930, p. 716.

gradually made its appearance also around and between all the other back teeth, both of the upper and lower jaw, as far as the canines. The child, who had hitherto been well, had eaten with good appetite and had increased in weight, now began to suffer from pains in her abdomen, and alternate spells of diarrhea and obstipation. As also the stomatitis was getting worse, and her teeth beginning to get loose, she was, on Nov. 21st, 1930, entered into the St. Hedvig's Clinic at Kolding. There her gums were treated by painting, and she was put on a suitable diet, with the result that when she was returned home again, on Jan. 25th,



Fig. 1.

1931, her condition was fairly good. In a short while the symptoms got worse again, however; wherefore she, a couple of months after, was admitted into the children's department of the State Hospital in Copenhagen, remaining there from March 21st to May 8th, 1931. According to communication from that institution, her case was diagnosed as gingivitis and osteitis mandibulae. The gingivitis was very pronounced, with diffuse, slightly bleeding tumefaction of the gums; the

mucosa of the buccae normal. Wassermann's and Pirquet's reactions both negative. No actinomyces granules or mycelia. During the whole of her stay, the swelling of the jaw, especially on the right side, continued to be marked, as well as that of the gum, with its tendency to bleeding. There was only slight inflammation of the glands in the neck. No signs of exophthalmus, polyuria or polydipsia. Sahli: March 27th, 83 (corr.), May 4th, 75 (corr.). Roentgen examination of the right and left halves of the jaw showed extensive destructions below and immediately back of the remaining molars, all the way down to the inferior border, and in the anterior part of the bone there was a rarefaction of the same character, of the form of a cyst. The treatment adopted consisted in cleansings of the mouth with ordinary salt water, plenty of fresh air, and a diet rich in vitamins.

After being discharged from the State Hospital, the child was again for some months treated at home, where she was, at the recommendation of the hospital, given potassium iodide and vigantol. Her teeth

became more and more loose, however; there was a terrible fetor from her mouth, and finally she was directed for ambulant treatment to the Municipal Hospital at Esbjerg, where, every week or two, one of her loose teeth was removed by means of a small forceps. By the middle of August, 1931, a soft, fluctuating tumor was discovered close to the external occipital protuberance. Roentgen examination of the skull (Fig. I) showed a destructive process, about 2.5 cm. long, near the latter. The destruction seemed to involve particularly the innermost layer of the cranial theca, while the outer contour of the skull was sharp and clear. There were no signs of pathological changes in the sella turcica. She was now treated with light-baths, and, besides, according to the recommendations from the State Hospital; but in spite of this her condition became steadily worse. She was always crying, her appetite was very poor, she lost weight, and her evening temperature was often as high as 38.8 to 39° . By the end of August and the beginning of September it was noticed that she began to suffer in a remarkable



Fig. II.

degree from thirst; she was continually asking for something to drink, and felt an incessant need for passing her water. Gradually, the condition became unbearable for her parents, and on September 17th, 1931, she was admitted into the Municipal Hospital of Esbjerg.

On admission she was very restless and cried loudly. She was very pale. Both her eyelids were slightly swollen, there was conjunctivitis on both sides, and an indication of bilateral exophthalmus. There was considerable stomatitis, with swelling, redness and abundant exudation of pus. All the teeth still remaining were loose. Strong fetor from the mouth. In the occipital region there was a tender, fluctuating tumescence, the size of a hen's egg, vallyately raised along its outward circumference. Large, tender lymph glands in both sides of the neck; tumor and tenderness of the suboccipital glands. Stethoscopy of the heart and lungs revealed nothing abnormal. The abdomen somewhat meteorically distended, specially above the umbilicus. No enlargement of

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the liver or spleen. The skin dry and squamous, with small petechiæ, specially on the chest. Temperature, 38.2° (it remained around 38° for some days, and was afterwards normal, except for some brief spells of fever now and then). Weight on admission, 18.8 kg. Complained continually about being thirsty, but not of any particular pain anywhere.

During the early part of her stay in the hospital she was very poorly, ate little, but drank great quantities of water, soda water, tea and milk.

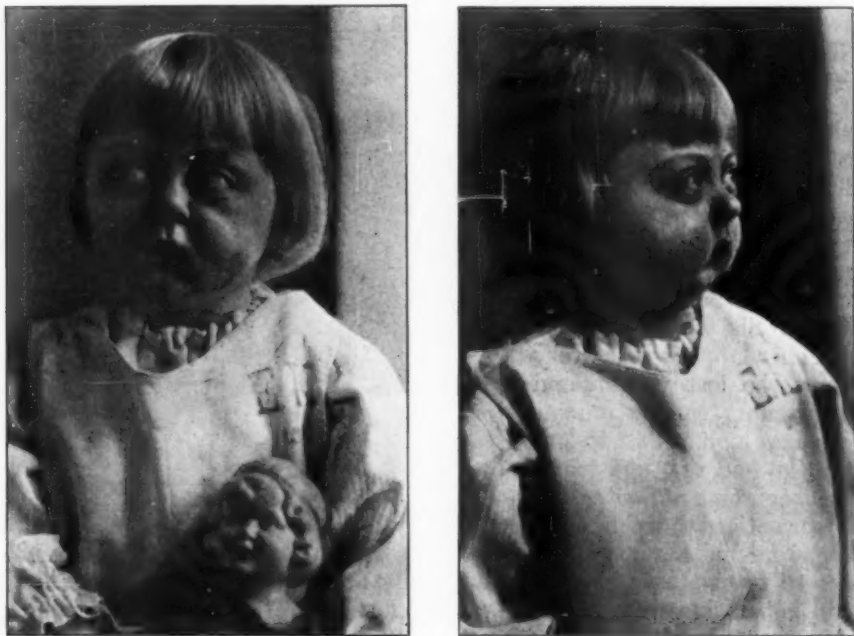


Fig. III.

The diuresis was in the beginning about 4,000 grams in twenty-four hours, and during the following year remained practically the same. Only by the summer of 1932 it became a little lower — about 3,500 grams. For some months she lost weight steadily. Thus, on Dec. 17th, 1931, she weighed only 12.5 kg. (as against the 18.8 kg. on admission), and around that figure her weight maintained itself afterwards. On Sept. 15th, 1932, she weighed 13 kg. For some time after her entrance the gastro-intestinal symptoms dominated. There was both diarrhea and obstipation; her abdomen was large and distended. Gradually, her liver became considerably enlarged, until its anterior border lay about

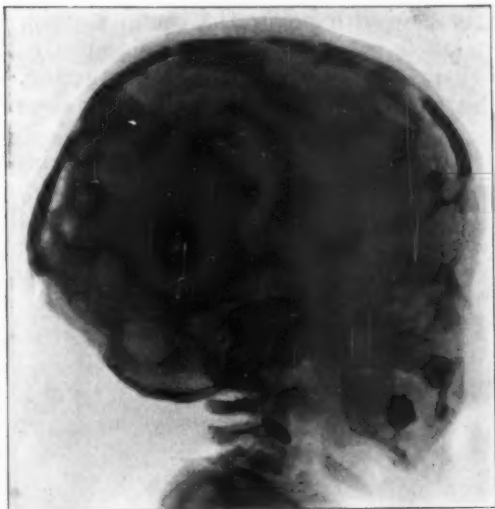


Fig. IV a.



Fig. IV b.

two or three fingers' breadth below the costal margin. There was no icterus, and no palpable enlargement of the spleen. In the frontal and parietal regions there appeared some new fluctuating, tender tumescences, and similar changes were noticed over the eleventh rib, on the right side.

Apart from these symptoms, her condition remained fairly stationary until the spring of 1932. It should be noted that the child's intelligence remained all the time well preserved, her vision, hearing and olfaction entirely unaffected by the disease. As she continued to complain of pain in her head, another roentgenogram of her skull (Fig. II)

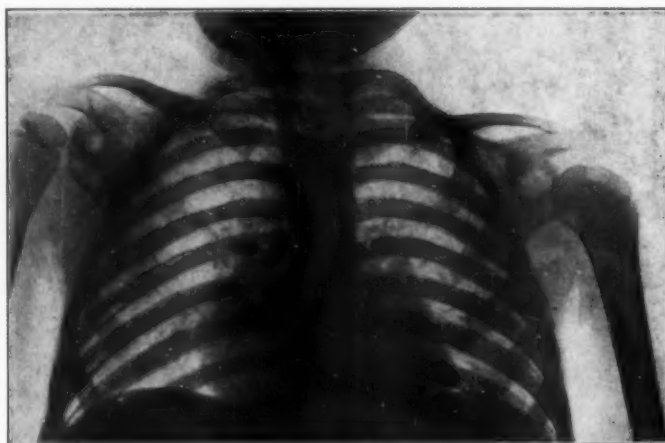


Fig. V.

was taken on March 2nd, 1932. It showed a very marked progress of the disease; there were about fifty oval or circular defects evenly distributed over the whole of the cranial theca. The sella turcia had been destroyed to the point of complete disappearance; also the bones of the face were largely involved. A roentgen examination of the spine and extremities showed nothing abnormal. Of the teeth, only two or three loose molars remained, and the body of the mandible had become almost entirely ulcerated away, so that the lower lip presented almost the shape of a funnel, with its point inward, toward the cavity of the mouth. The two photographs, Fig. III, give a good impression of the child's appearance at the time.

At times she was very feeble, almost moribund; then, after a while, she would pick up again, would be able to walk about a little, and would be playing with the other children in the ward. The disease progressed

steadily, however; and its various stages could be followed through a series of successive roentgen examinations. Thus, in a roentgenogram taken on Aug. 13th, 1932, it is seen (Fig. IV a & Fig. IV b) that the isolated cranial defects have merged together into large, irregular areas, and the facial bones and most of the mandible become destroyed by ulceration. It is the condition which by one author has been described as resembling a geographical map, while CHRISTIAN very aptly speaks of the »moth-eaten» appearance of the skull. A roentgen examination of the whole skeleton on Aug. 26th, 1932, revealed similar destructive changes in the right humerus, both scapulæ, several ribs, the ninth thoracic vertebra, the pelvis (iliac and pubic bones) and the left femur (Fig. V, Fig. VI & Fig. VII). As there had for some time been no further decline in her general condition, and as one of the other children in the ward got varicella, she was discharged and sent home on Sept. 29th, 1932.



Fig. VI.

She now remained at home for about four months and a half, during which time she was tended and looked after by her mother. The task was a very difficult one. She soiled herself, and was often irritated, but there was never any sign of waning intelligence. The only loss of sensations noticed was a steadily increasing deafness and, on one, single occasion, a brief, passing spell of blindness, when she cried over not being able to see, and asked for the lamp to be lit in the middle of the day. She often complained of earache, and *twice there was a discharge through the external acoustic meatus — once from the right, and once from the left — of oblong, perforated bone splinters resembling sequestræ*. Associated with this there was a slight otorrhea, but of brief duration.

As her condition again became worse, she was once more admitted into the Esbjerg Municipal Hospital, on February 4th, 1933. There was now observed a *very considerable increase in the volume of the head*, the appearance of which was absolutely hydrocephalic, with several fluctuating protuberances, each as large as the half of hen's or goose's

egg. On palpating the head, one had the same sensation as when pressing on a flabby, badly blown-up rubber ball. The whole of the head was very tender to any contact. Also the exophthalmus had greatly increased, and the child was almost completely deaf. There was a slight edema of the eyelids and forehead, but no strabismus; and the movements of the eyes, as well as those of all the joints of the body, were free and



Fig. VII.

natural. The abdomen was very large; the inferior border of the liver lay three fingers' breadth below the costal margin. The weight was as before, — 13 kg.; the diuresis about 3,750 grams, the specific gravity 1,002 to 1,004. The urine was clear and acid; microscopy and chemical tests showed normal conditions; Bence-Jones' albumin test was negative. She was up most of the time, walked about a little, and could play a little with the other children in the ward. There were also periods, however, in which she was extremely weak, and had to remain in bed for a week or two at the time. On april 15th, she had a sudden attack of convulsions and collapsed on the floor. She was lucid and replied when spoken

to, but wailing and loudly crying. A few minutes after, she fell into a state of coma, her respiration became snoring and she became very cyanotic. After another fifteen or twenty minutes she died, without further convulsions.

As it had been practically impossible to make any roentgen examination of her skull at the time of her last admission, I took a couple of roentgenograms of the cranium after death, which will be seen in Figs VIII a and VIII b.

For the sake of readier survey I set down together the results of the

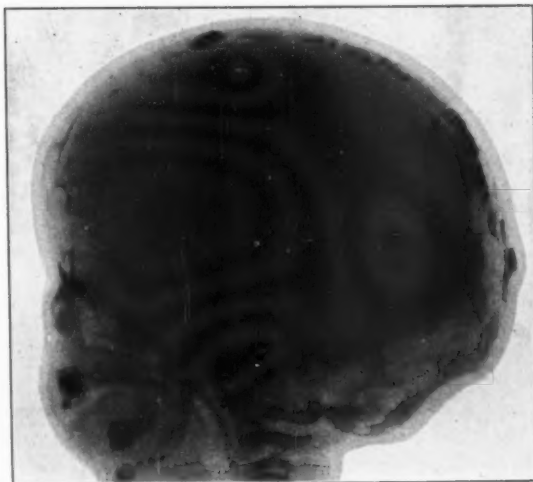


Fig. VIII a.



Fig. VIII b.

various tests undertaken, and the observations with regard to a number of symptoms either present or absent in the case.

Blood: The erythrocytes were of fairly normal size. No polychromasia; no nucleated red cells. Numerous platelets. The leucocytes conspicuously numerous. Apparently no unripe forms. Differential count: lymphocytes, 59.2 per cent.; neutrophile leucocytes, 38.5 per cent.; monocytes, 1.5 per cent.; eosinophile leucocytes, 0.8 per cent. Blood count, 4,800,000 erythrocytes per c.mm.

Pirquet, negative. *Wassermann*, negative. *Urine*, no pathological contents; Bence-Jones' albumin test, several times repeated, invariably negative; specific gravity, 1,001—1,005. *Hemoglobin*, on admission, 75 per cent.; at discharge, 68 per cent. (corr. Sahli). *Blood sedimentation*, 30 mm. in 1 hour. *Strauss' water test*: 8 a. m., 36/1,003; 9 a. m., 210/1,001; 10 a. m., 200/1,000; 11 a. m., 100/1,002; 12 noon, 60/1,001; 2 p. m., 70/1,006; 4 p. m., 150/1,003; 6 p. m., 80/1,005. *Ophthalmoscopy*: no enlargement or palishness of the papilla, but their contours somewhat effaced; here and there sinous, somewhat dilated vessels. No effusion of blood.

There was never any strabismus or any yellow spots in the skin. No signs of adiposogenital dystrophy or infantilism. No dyspnea or stertorous respiration. Her walk was natural. At times there was some slight otorrhea and temporary deafness. Never any icterus. The shape of her skull was normal. Never any headache. No sores in her scalp. Often pains in the region of the hip, and more lately a tenderness of the whole body. No particular pain in the back.

During the first part of her stay in the hospital the treatment was entirely symptomatic. Later, a metallosal cure was prescribed, and she was given a series of quartz-light treatments. For a while she was given pituitrin; but this, like all the other treatments, proved of no effect whatever.¹

When the existence of the disease is borne in mind, its diagnosis is very easy as soon as Christian's syndrome is present. Still, I have found four cases reported — respectively by SCHULTZ, SCHOTTE, PUHL and WERMTE — in which there existed only the characteristic bone defects, but no exophthalmus or diabetes insipidus. The xanthomatous eruption on the skin, which of course to a certain extent makes the diagnosis easier, is described in several cases, among others by HAND and HERTZENBERG. Arrested growth and pains in the head, back and bones are by no means rare symptoms. Others, more frequent, are, in the first place, adiposogenital dystrophy and enlargement of the liver, a con-

¹ In a paper: 'Xanthomatosis', in The American Journal of Roentgenology and Radium Therapy (June, 1930), M. C. SOSMANN strongly advocates roentgen treatment in these cases.

strained walk and dyspnea; second to these hydrocephalus, yellow spots in the retina and icterus. Finally one finds, in a few instances, infantilism, neuritis of the optic nerve and strabismus.

Examination of the blood seems to have been made only in very few cases; thus by HERTZENBERG, who in one instance found the erythrocyte count to be 740,000 and the hemoglobin percentage 7.8; and by Rowland, who in one case found 32 per cent. of monocytes. Hypercholesterolemia, too, is referred to only in a couple of cases, namely by ROWLAND, who found 397 mg. per cent. of cholesterol in the blood, and GRIFFITH, who found 315 mg. per cent.; while SOSMANN, HOEFER and LAZAREWNA found normal values in this respect.

To the more immediate diagnosis, the osseous changes will always be the principal key, however. ANNA LAZAREWNA, in a recently published paper,¹ gives the number of fairly well examined cases reported up to the time of her writing as twenty-seven, and tabulates the osseous changes found in these as follows:

	Number of cases	Percentage
Skull	27	100 %
Sella turcica	5	10 »
Upper jaw and facial bones	7	26 »
Lower jaw	6	22 »
Pelvis	14	52 »
Spinal column	3	11 »
Costæ	4	15 »
Scapula	1	4 »
Femur	7	26 »
Humerus	3	11 »

It will be seen from this that in the case observed by me the extent to which the disease had involved the skeletal system was exceptionally great, the osseous changes being found in every one of the localities mentioned by previous authors.

It is extremely doubtful whether any therapy exists that will avail against this generalised xanthomatosis. After having followed the above case, day by day, for a year, seeing how the various symptoms developed and how one part of the osseous structure broke down after the other, I feel that we are here confronted by a disease whose prognosis is infinitely sad, and where the only gleam of therapeutical light to be hoped for may possibly come from the roentgen rays.

¹ LAZAREWNA, A.: Die Knochenforme in Xanthomatosis (Fortschr. a. d. Geb. d. Roentgenstrahlen vol. XLV, fasc. 5, 1932; p. 692).

SUMMARY

The author reports a case of generalised xanthomatosis in a girl aged 4 years. The disease has also been described under the names of dyspituitarism and Christian's syndrome, the latter denoting a triad of symptoms made up of osseous changes, specially in the skull, diabetes insipidus and exophthalmus. In the case described by the author, the osseous changes were found in almost every part of the skeleton, there was considerable exophthalmus, and the diuresis was about 4,000 grams per twenty-four hours. The first symptoms were gingivitis, loose teeth with strong pyorrhea, and osseous defects in the lower jaw. Bence-Jones' albumin reaction was negative. Quartz-light treatment, injections of pituitrin and a metallosal cure were tried, but all to no effect.

ZUSAMMENFASSUNG

Der Verf. berichtet über einen bei einem 4jährigen Mädchen beobachteten Fall von verallgemeinerter Xanthomatosis, welche Krankheit auch unter den Namen Dyspituitarismus und Christiansches Syndrom beschrieben wurde. Dieses Syndrom besteht aus einer Trias von Symptomen: Krankhaften Veränderungen im Knochensystem, besonders am Schädel, Diabetes insipidus und Exophthalmus. In dem vom Verf. beschriebenen Falle waren die Knochenveränderungen nahezu in jedem Teil des Skeletts zu finden, es bestand beträchtlicher Exophthalmus, und die 24stündige Harnmenge betrug ungefähr 4,000 g. Die ersten Symptome waren Gingivitis, Lockerung der Zähne mit starker Pyorrhoe und Knochendefekte im Unterkiefer. Bence-Jones Albuminreaktion war negativ. Es wurden Quarzlichtbehandlung, Pituitrininjektionen und eine Metallosalkur versucht, aber alles ohne Erfolg.

RÉSUMÉ

L'auteur communique un cas de xanthomatose généralisée chez une fillette de 4 ans. Cette affection a été également décrite sous la dénomination de dyspituitarisme ou de syndrome de Christian, comprenant une triade de symptômes suivants: altérations osseuses, plus particulièrement au niveau du crâne, du diabète insipide et de l'exophtalmie. Dans le cas décrit par l'auteur, les lésions osseuses se retrouvaient dans toutes les parties du squelette; l'exophtalmie était considérable et la diurèse atteignait environ 4,000 gr. par 24 heures. Le premier symptôme fut de la gingivite avec déchaussement des dents et pyorrhée marquée et altérations osseuses du maxillaire gauche. La réaction de Bence-Jones était négative. Traitement par la lampe de quartz, injections de pituitrine et cure de sels métalliques: la thérapeutique resta sans effets.

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ROENTGEN TREATMENT OF XANTHOMATOSIS¹

by

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(Tabulæ LXVII—LXVIII)

Roentgen Treatment of Xanthomatosis

The case of xanthomatosis, referred to in »Acta Radiologica», vol. XII. Fasc. 3, having been subjected to a systematic roentgen radiation, we now proceed to give an account of observations of radiological and clinical significance made during this treatment.

During the two years which have elapsed since our previous publication, the patient has been under frequent clinical as well as radiological control. The pathological changes in the bone system have presented numerous variations and surprises. Now as previously, only the most important and characteristic changes will be mentioned.

On the roentgenogram of August 26th., 1931, Fig. I a we see in the first place that the previously described clearings have disappeared. The skull no longer bears the map-like appearance, which is so characteristic of the syndrome. In various places, the skull shows small irregular clearings or defects which, however, are not sharply outlined. Thus, a regeneration of the bone substance has taken place, filling up most of the defects of the lamina interna. On the other hand, we find fresh pathological changes which are, no doubt, of great interest. On the left side (stereo), a loosening of the floor of the frontal skull cavity of about 2 cm.'s extension is seen, the separated fragment including the processus clinoidus anterior. On the lateral picture of the skull, Fig. I b, taken one year later, October 26th., 1932, we find that the vessel and diplo-designs are nearly normal.

The anterior skull cavity shows a small defect of the lamina interna. Aside from this, the inside is perfectly even and of normal appearance.

¹ Submitted for publication July 5th, 1933.

The floor of the frontal cavity now appears intact without any trace of a loosened fragment. The sella turcica has a normal shape, sharply edged. The regression has continued and seems now to be practically complete.

A systematic radiological examination of the patient's bone system in 1930 showed changes *only* in the skull. During the course of the intervening two years, however, the process has spread to other parts of the skeleton, principally to the spine, the pelvis and the right femur. These manifestations or «metastases» appeared at intervals of several months and were accompanied by severe local pains. Roentgen examinations enabled us to observe both progress and retrogression of each new «focus». By means of local roentgen treatment, we were able to stop and to defeat each new attack. We shall revert to this matter later on.

A roentgenogram taken May 30th., 1931, Fig. II, shows an attack of the fifth cervical vertebra. The latter is considerably diminished in height and bears irregular coarse-mashed designs. It is the seat of a bone destruction, chiefly confined to the frontal part, where the height of the vertebra is reduced to less than a half. The vertebra thereby nearly assumes a sphenoid shape. The vertebral disc above is also affected, the intervertebral space being considerably lower than usual. The fifth cervical vertebra is thereby made to adjoin closely the vertebra above.

In the other parts of the spinal column, the roentgenograms reveal similar changes, though less pronounced. Nearly the whole of the thoracic spine shows reduced calcification, and the vertebrae are lower than normal with an imperfect development of the epiphysis at the limbus. Several vertebrae are considerably reduced in height, yet do not show such a pronounced compression as the fifth cervical vertebra. On the same day, namely May 30th., 1931, the roentgenograms showed pathological changes in the ala ossis ilei on both sides. On Fig. III a, small, round, almost symmetrical clearings, densely amassed, are seen, forming a coarse-mashed network, surrounded by an area of thickened bone substance.

A roentgenogram taken August 26th., 1931, Fig. IV a, revealed a more than nut-sized defect of the bone just above the middle of the femoral diaphysis. This defect widened the medullar cavity and attacked the corticalis on both sides. Around this defect the bone showed a fusiform thickening, produced by thick, periostitital layers on both sides. This peculiar change strikingly reminds us of an osteomyelitic focus or a tumor metastasis. The interesting fact is that roentgenograms taken one year later, October 26th., 1932, showed an almost total regression of the process both in pelvis and femur. (Fig. III b. Fig. IV b).

Roentgen Treatment

As mentioned in our first publication, we already commenced the X-ray treatment of the patient in 1930. We then irradiated the cranium, wherever defects of the bone were manifest. On the roentgenograms taken two years later, we see that the treatment has been highly efficacious.

We have had rich opportunity of ascertaining the *direct* influence of the irradiation on the xanthomatous infiltrations. Whenever new localizations were detected in the bone system, roentgen treatment was immediately applied. The effect of this treatment was most favourable and, as a rule, instantaneous.

About May 5th., 1931, the patient began to complain of strong pains in the back of the neck, irradiating along the shoulders. At the same time, the patient had difficulty in moving the head, every twisting of the neck causing pain. The patient then received three roentgen treatments, and only a few hours later she was free from pain. On later examinations we could ascertain that the process in the vertebrae had receded and that the bone substance was regenerated with almost normal designs. The patient furthermore received treatment of the ala ossis ilei on both sides and of the focus in the right femur. In both places the local treatment was successful, both with regard to pains and bone changes. The changes in the bone system now presented by the patient are so insignificant that they would probably pass unnoticed unless suspected.

Technique

Roentgen therapy is administered as a common treatment in inflammatory cases, $\frac{1}{2}$ mm., copper filter, 40 cm. distance, 160 Kv., 4 ma. and 150 r., at each sitting. This treatment has proved to be fully satisfactory in improving the symptoms mentioned. As far as we understand, it should not be necessary to use more powerful and penetrating rays. The small doses applied showed in every case a surprising, accurate effect.

Clinical Observations

Below we shall give a short description of the clinical development, seen in connection with the X-ray treatment. The table arranged below shows the variations of the most prominent symptoms.

During the patient's first stay in the Neurological Section, from January to July 1930, she had symptoms of increased intracranial pres-



Fig. I a.



Fig. I b.



Fig. II.



Fig. III a.



Fig. III b.



Fig. IV a.



Fig. IV b.

Effect of Roentgen Treatment on Symptoms of Xanthomatosis

Treatment	Papilledema	Exophthalmos	Diuresis	Growth	Cholesterol determinations
	R. L.				
	²⁰ / ₁ 30. 0 diopt. 0 d.	¹⁵ / ₁ 30. 2 mm.	January— March 1928	Height:	
	⁸ / ₈ 30. 1 , 1 ,	²⁷ / ₈ 30. 2 ,	2000—4000 cc.	Jan. 28. 137 cm.	
	¹⁰ / ₈ 30. 2 , 1.5 ,	¹ / ₇ 30. 2.5 ,		Jan. 30. 137.5 cm.	
	⁹ / ₈ 30. 2 , 2 ,				
¹⁴ / ₈ — ²² / ₈ 30. Cranium.			August— Sept. 1930		¹² / ₈ 30. Cholesterol 207 mgr. 100 cc.
²⁴ / ₁₀ — ³¹ / ₁₁ 30. Cranium.	⁴ / ₁₁ 30. 1 diopt. 1 d.	⁴ / ₁₁ 30. 1.5 mm.	1500—2900 cc.	³⁰ / ₈ 30. 139.5 cm.	
¹¹ / ₁₃ — ¹⁴ / ₁₃ 30. Pelvis.					
²⁰ / ₁ — ⁹ / ₂ 31. Pelvis & femur.				²² / ₈ 31. 139 cm. ²⁸ / ₈ 31. 137.5 cm.	
⁹ / ₆ — ¹⁶ / ₆ 31. Spine & pelvis.					⁶ / ₆ 31. Cholesterol 173 mgr. 100 cc.
²¹ / ₅ — ²⁴ / ₆ 32. Neck.				²⁷ / ₈ 32. 141 cm.	
²¹ / ₁₀ — ² / ₁₁ 32.	²⁶ / ₁₀ 32. 0 diopt. 0 d.		October 1932 1700—2000 cc.	²⁶ / ₁₀ 32. 143 cm.	⁷ / ₁₁ 32. Cholesterol 92.9 mgr. 100 cc.

sure. Bilateral papilledema developed, and the patient constantly complained of headache and dizziness. After two series of treatment of the cranium, the prominence of the discs commenced to diminish, and at the last control it was reduced to zero. The other pressure symptoms had also disappeared. A similar effect was seen on the left-sided exophthalmus, which during the treatment diminished visibly and measurably.

The growth has shown some interesting features. During the first years practically at stand-still, the height, during the period from March 22nd., 1931, to May 28th., 1931, was reduced with nearly 2 cm. This phenomenon is undoubtedly due to the fact that the process at this time was localized to the spine. In the course of the following fifteen months, the height increased with nearly 6 cm.

The diuresis has on the whole shown a falling tendency. During January—March 1928, it varied between 2,000—4,000 cc., during August—September 1930 between 1,500—2,900 cc., and at the last observation in October 1932 between 1,700—2,000 cc.

The values of blood cholesterol are of great interest in view of the supposed underlying disturbance of the fat metabolism. In August 1930, a hyper-cholesterolemia was found (207 mg. 110 cc.), which was still present in June 1931 (173 mg. 100 cc.). At the last determination in November 1932, a normal value (92.9 mg.) was found.

Besides the roentgen radiation a treatment with a low fat-diet and pituitary extract (Pituit-injections) was tried. The pituit treatment had no effect on the polydipsia and polyuria. On the basis of our experiences, we dare not pronounce any definite statement as to the value of the low fat-diet. The treatment extended over about three months (January—April 1931). The clinical picture during this period presented the same variations as before, and a new outbreak of the disease — namely the attack on the spine — occurred, while the patient was kept on a low fat-diet.

SUMMARY

The authors describe the roentgen treatment in a case of xanthomatosis. The treatment has been applied to the different foci and had always an accurate and striking effect. Radiograms show a gradual diminution of the xanthomatous areas, and a corresponding regeneration of bone substance.

Parallel with the favourable effect on the local processes, a striking improvement of the secondary symptoms and the general condition has taken place.

Symptoms of intracranial pressure have disappeared, the growth of the patient has increased, the blood cholesterol has been reduced to normal values. After two years' observation the patient is practically free from symptoms.

ZUSAMMENFASSUNG

Verf. beschreibt die Röntgentherapie in einem Falle von Xanthomatosis. Die Behandlung wurde auf die verschiedenen Herde gerichtet und hatte immer eine exakte und überraschend gute Wirkung. Die Radiogramme zeigen eine allmähliche Verkleinerung der xanthomatösen Gebiete und eine entsprechende Regeneration der Knochensubstanz.

Parallel mit der günstigen Wirkung auf die lokalen Prozesse trat eine augenfällige Besserung der sekundären Symptome und des Allgemeinzustandes ein.

Die Symptome von intrakranialem Druck verschwanden, der Patient wuchs, und der Cholesterolgehalt des Blutes verringerte sich auf normale Werte. Nach 2jähriger Beobachtung ist der Patient praktisch genommen symptomfrei.

RÉSUMÉ

Les auteurs décrivent le traitement radiologique d'un cas de xanthomatose. Le traitement fut appliqué aux divers foyers et donna dans tous les cas un résultat manifeste et marqué. Les radiogrammes permirent de constater une diminution progressive des foyers xanthomatiques et une régénération correspondante de la substance osseuse.

Parallèlement à cet effet local favorable, on constata une amélioration frappante des symptômes secondaires et de l'état général.

Les signes de pression intra-crânienne disparurent, la taille du malade augmenta et le cholestérol du sang revint à une valeur normale. Au bout de deux ans d'observation, le malade est pratiquement exempt de symptômes.

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EIN GERÄT ZUR EINSTELLUNG TYPISCHER UND ATYPISCHER FERNAUFNAHMEN¹

von

Dr. R. Sandera

Mit 10 Abbildungen (Tabula LXIX)

Die grundsätzlichen Vorteile der Röntgen-Fernaufnahme sind oft in theoretischen Erwägungen dargelegt worden, häufig auch in praktischer Hinsicht für die Röntgenographie mancher Organe und Organteile bewiesen worden, sodass sich ein neuerliches Eingehen auf diese Dinge hier erübrigt. Uns scheint jedoch, dass die Technik der Fernaufnahme in ausgedehnterem Maße verwendet werden könnte und wir glauben, dass eine besondere Ursache für die noch eingeschränkte Verwendung dieser Aufnahmeart in gewissen Schwierigkeiten einer genauen Einstellung liegt, falls man nicht komplizierte Aufnahmestative zur Verfügung hat. Wenn wir in dieser Mitteilung über eine Art der Einstellung von typischen und atypischen Aufnahmen berichten, sind wir der Meinung, einen Teil dieser Hemmnisse beseitigt zu haben. Einfachheit und Genauigkeit unserer Einstellungsart ermöglichen nicht nur eine ausgedehntere Verwendung der Tele-Röntgenographie, sondern geben uns auch die Möglichkeit, mit jeweils kleinsten Bildformaten zu arbeiten, was selbstverständlich auch einen ökonomischen Vorteil bedeutet.

Nach einer kurzen Beschreibung unserer Technik, die wir nun seit einem Jahre ausüben, geben wir einige Beispiele von Einstellungen zu Fernaufnahmen.

Die Einstellvorrichtung, ang. als Patent und Gebrauchsmusterschutz (Abb. 1), besteht aus einer Platte, die an einer Seite zum Durchführen des Tubusgewindes der Röntgenröhre eine Kreisöffnung trägt. An der anderen Seite gehen zwei Querflächen ab, deren waagrechte Wasserwaagen und deren senkrechte eine bewegliche Tragplatte für Klemmen trägt, in die ein optischer Sucher mit Fadenkreuz eingeschoben wird.

¹ Bei der Redaktion am 20. V. 1933 eingegangen.

Entsprechend angeordnete Schrauben ermöglichen ein Feststellen der Tragplatte in jeder Zwischenstellung. Dies ist wichtig, denn unsere Methode der Einstellung erfordert eine einmalige genaue Parallelstellung der Achse des Zentralstrahles des optischen Suchers zum Zentralstrahl der Röntgenröhre und die verlässliche Fixation des ersteren in dieser

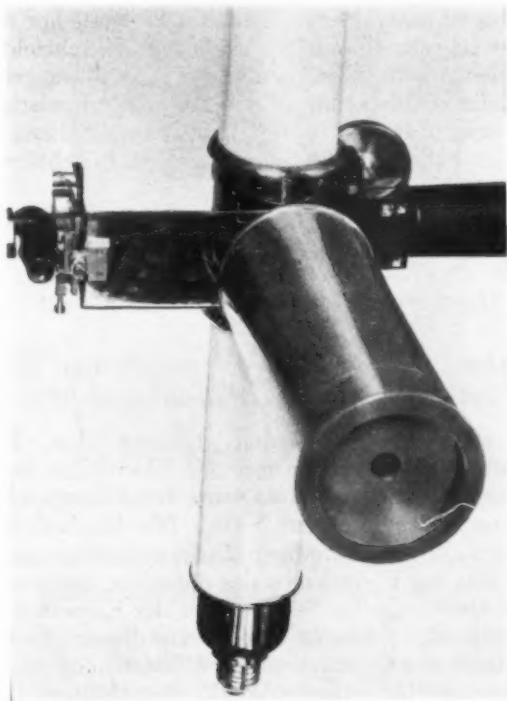


Abb. 1. Einstellvorrichtung mit optischem Sucher und variablem Tubus.

Parallele. Mit erfolgter Parallelstellung unter Kontrolle des Auges und der Fixation des Suchers in der Parallele ist das Prinzip der Methode gegeben: Es besteht 1) im Anvisieren des Mittelpunktes des zu röntgenografierenden Objektes im Fadenkreuz des optischen Suchers und 2) im Ersetzen des Visierzentralstrahles durch den Zentralstrahl der Röntgenröhre mittels planparalleler Verschiebung der Röntgenröhre um den gleichbleibenden Abstand dieser beiden Zentralstrahlen, einmal gemessen und vermerkt am Stativquerarm. Wie die Bildmitte bestimmt wird, bzw. wie Eintrittspunkt und Austrittspunkt des Zentralstrahles am Ob-

jekte mit dem Kassettenmittelpunkte in projektorische Deckung gebracht werden, soll hier an einigen Beispielen gezielter Aufnahmen im waagrecht Zentralstrahl bei aufrechter und bei geneigter Kassette gezeigt werden. — Zuvor noch eine Bemerkung über den von uns bei Fernaufnahmen verwendeten *Tubus* (s. auch Abb. 1): da zur Verminderung der Streustrahlung, damit steigender Verbesserung der Bildschärfe, dann aus Gründen des Streustrahlenschutzes für Untersucher und Untersuchten es angezeigt ist, das jeweils kleinst nötige Leuchtfeld auszublenden (das zu verwenden uns die Genauigkeit der Einstellung gestattet), ist der 21 cm lange Zylindertubus mit auswechselbaren Kreisringen versehen, die Öffnungen von 1.25 cm bis 6 cm freigeben. Ihnen entspricht bei einer Brennpunkt — Schichtdistanz von 2m ein Leuchtkreis vom Durchmesser von 13 cm bis 50 cm.

Unser Kassettenträger besteht aus zwei aufrechtstehenden U-Schienen, in denen ein in jeder Höhe feststellbarer Rahmen gleitet. Das Aufnahmestativ ist ein leichtes Lambertz-Universalstativ, das an einem verschiebbaren Querarm eine Strahlenschutzröhre trägt.

Beispiele typischer Fernaufnahmen bei waagrechtem Strahlengang und senkrechter Kassette (Einfallswinkel 90°).

Einstellung einer *Lungenaufnahme*: Distanz 2 m, Tubusöffnung 6 cm. Zuerst wird der Tragrahmen mit der Kassette in richtige Höhe gebracht und fixiert. Die richtige Höhe wird durch Vergleich am Patienten kontrolliert, dann tritt dieser zur Seite. Die Einstellvorrichtung wird eingestellt auf den mit einer ständigen Marke gekennzeichneten Kassettenmittelpunkt, indem das Fadenkreuz des optischen Suchers durch Höhenverschieben des Querarms des Statives mit der Kassettenmarke zur projektorischen Deckung gebracht wird. In dieser Stellung wird das Stativ fixiert, dann der Querarm um den feststehenden Betrag des Abstandes Sucherachse-Röhrenzentralstrahl verschoben. Zur Aufnahme lehnt sich der Pat. mit der Brust an die Kassette, mit Oberarmen in halber Abduktion, mit den Ellenbogengelenken in halber Flexion, die Handrücken etwas ober den Darmbeinkämmen den Flanken plan anliegend (dadurch werden die Schulterblätter gänzlich oder zum Grossteil aus der Projection der Lungenfelder herausgebracht).

Einstellung einer Fernaufnahme der *Halswirbelsäule seitlich*: Distanz 2 m, Tubusöffnung 2 cm, Format 13/18 (Abb. 2). Pat. sitzend, eine Schulter etwas geneigt unter den Kassettenrahmen geschoben und die andere Schulter etwas zurückgenommen, gegebenenfalls gestützt. Nun wird durch Höhenverschieben des Stativquerarms das Fadenkreuz des Suchers in projektorische Deckung mit dem Zeichen der Kassettenmitte gebracht, zu deren Sichtbarmachen der Pat. den Hals etwas zurückneigt.

Nach Fixieren des Querarms wird (wie oben) durch Seitenverschiebung an Stelle des Visierzentralstrahles der Zentralstrahl der Röntgenröhre gebracht und die Aufnahme angeschlossen.



Abb. 2. Einstellung einer seitlichen Aufnahme der Halswirbelsäule.

Beispiele atypischer Fernaufnahmen bei waagrechtem Strahlengang und senkrechter Kassette (Einfallswinkel 90°).

Aufnahmen dieser Art fixieren bildlich ein bei Durchleuchtung in den sogenannten atypischen Richtungen (in solchen, die in den Ebenen zwischen sagittalem und frontalem Strahlengang liegen) gesehenes Röntgenbild. Bisnun war es hierzu notwendig, am Durchleuchtungsstativ zu röntgenographieren, was entweder die Aufnahme in Nahdistanz oder die Verwendung eines Spezialstatives erforderte, ferner die Einschaltung der Aufnahme in den Vorgang der Durchleuchtung nötig machte.

Unsere Methode der Fernaufnahme macht uns vom Durchleuchtungsstativ zeitlich und räumlich unabhängig, weil sie ermöglicht, die gezielte Aufnahme in dem bei der vorangegangenen Durchleuchtung festgelegten Strahlengang auszuführen, und dies an einem beliebigen Universalstativ. Da wir (siehe oben) diese Fernaufnahmen im waagrechten Zentralstrahl ausführen, müssen wir uns einmal am Durchleuchtungsstativ und am Aufnahmestativ jene Stellung der Röhre vermerken, bei der der Zentralstrahl in der Waagrechten verläuft. Dieser Vorgang sei beispielsweise

an einem Durchleuchtungsstative mit neigbarer Röhre und gekoppeltem Gang von Röhre und Leuchtschirm dargestellt. Dazu werden vorübergehend an Stativwand und Rückwand des Leuchtschirms zwei Bleimarken in gleicher Höhe vom Boden angebracht. Deren Schatten werden durch Neigen der Röntgenröhre in kleinstem Blendenfelde zur Deckung gebracht. Bei dieser Röhrenstellung läuft dann der Zentralstrahl in der Waagrechten. Analog erfolgt die Bestimmung des waagrechten Zentralstrahles am Aufnahmestativ: bei der gebrauchten Entfernung, z. B. von 2 m, wird bei kleinster Blendenöffnung eine nicht mehr gebrauchte Verstärkungsfolie mit Durchleuchtungslicht belichtet. Diese Folie ist in gleicher Höhe, in der sich der Focus der Röhre befindet, gekennzeichnet. Die Röhre wird nun so gestellt, dass der Mittelpunkt des Leuchtkreises

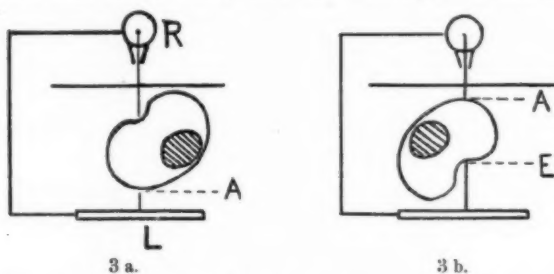


Abb. 3. Schema der Bestimmung des Ein- und Austrittspunktes des Zentralstrahles bei der Durchleuchtung:

3 a: Bestimmung des Austrittspunktes A; 3 b: Drehung um 180°, Bestimmung des Eintrittspunktes E.

sich mit der Kennzeichnung der Folie deckt. Bei dieser Stellung wird der Stand der Luftblase der einen Wasserwaage angezeigt und bei späteren Aufnahmen die Röhre auf dieses Zeichen hin eingestellt.

Einstellung einer *Thorax (Détail)-aufnahme* in atypischer Richtung:

a) Durchleuchtung: Es handle sich um die röntgenografische Darstellung einer in atypischer Durchleuchtungsrichtung charakteristisch sichtbaren Einzelheit, z. B. einer Lappenrandverdichtung, eines interlobären Flächenschattens, Hilustumors, Fremdkörpers u. ä. Man dreht den Pat. so, dass im waagrechten Strahlengang bei kleiner Ausblendung diese Einzelheit sich deutlich darstellt und versieht dann den Austrittspunkt des Zentralstrahles am Pat. mit einer Bleimarke (Abb. 3 a Punkt A), dreht dann den Pat. bei unveränderter Schirm- und Blendenstellung um 180°, bis also der Schatten der Bleimarke wieder im ausgeblendeten Feld am Leuchtschirm sichtbar wird (Abb. 3 b, Punkt E). Dieser Punkt E, der Eintrittspunkt des waagrechten Zentralstrahles bei der früheren Stellung wird durch eine Hautmarke mit Fettstift o. ä. bezeichnet, ebenso wie die Bleimarke an Punkt A nun durch eine Hautmarke ersetzt

wird. Es ist klar, dass mit diesen Kennzeichen für jeden waagrechten Strahlengang Ein- und Austrittspunkt des Zentralstrahles zu einer genauen bildlichen Wiedergabe des bei der Durchleuchtung gesehenen Bildes gegeben sind (abgesehen von der Verminderung der Verzerrung der Bildmasse bei Aufnahme in grösserer Entfernung als die der Durchleuchtung). Bei gleicher Stellung des Pat., wobei auch auf gleiche Stellung der oberen und unteren Extremitäten zu achten ist, kann also an einem beliebigen Aufnahmestativ im waagrechten Strahlengang die Röntgenaufnahme nachgetragen werden.

b) Aufnahme: zuerst wird durch Vergleich mit den Hautmarken des Pat. der Mittelpunkt der Kassette im Rahmen auf entsprechende Höhe

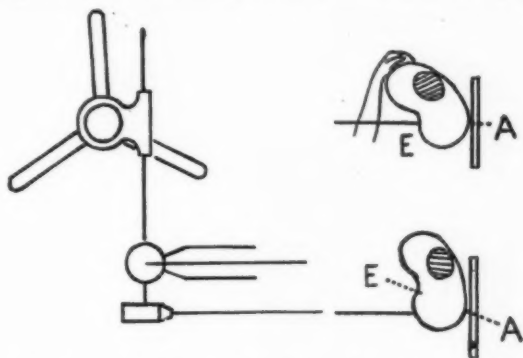


Abb. 4. Einstellung zur Aufnahme: Punkt A wird mit der Kassettenmitte zur Deckung gebracht, Punkt E erscheint bei Drehen des Patienten im Fadenkreuz des Suchers.

eingestellt, dann das Fadenkreuz des Suchers projektorisch mit der Kassettenmitte zur Deckung gebracht, dann der Pat. mit der Hautmarke A an die Kassettenmitte gestellt (siehe Abb. 4) und von der Assistenz so gedreht, dass Punkt E im Fadenkreuz erscheint. Nun entspricht in der Projektion der Kassettenmittelpunkt dem Mittelpunkt des früheren Durchleuchtungsbildes, die Punkte A und E wie früher dem Zentralstrahlaustritts-, bzw. Zentralstrahleintrittspunkt, das Fadenkreuz des Suchers dem Focus der Durchleuchtungsröhre. Es wird also (abgesehen von der Minderung der Grössenverzerrung der Nahdurchleuchtung) das Aufnahmebild dem der Durchleuchtung gleich. Schliesslich wird nach Parallelverschiebung der Röhre röntgenografiert.

Beispiele.

Bei der Beschreibung der Aufnahmerichtungen unserer atypischen Aufnahmen mussten wir mit genaueren Daten arbeiten, als sie die ge-

wohnten Bezeichnungen nach Durchmessern zuliessen. Wir benützen dazu gedachte Verbindungslinien der Ziffern eines Uhrblattes, auf das

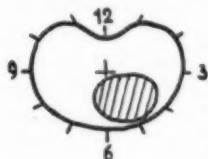


Abb. 5. Schema eines Thoraxquerschnittes, regionär gekennzeichnet nach Ziffern eines Uhrblattes.

wir das Schema eines Thoraxquerschnittes projizieren (Abb. 5). Die bei den folgenden Beschreibungen zuerst genannte Ziffer bezeichnet den Punkt E als Eintrittspunkt, die zweitgenannte Ziffer den Punkt A als Austrittspunkt des Zentralstrahles. Abb. 6 a zeigt einen rechtsseitigen Ausschnitt aus einer Lungenaufnahme, welche die uns interessierende Einzelheit, einen dem rechten Hilus aufsitzenden eiförmigen Tumor nicht erkennen lässt, Abb. 6 b gibt diesen gut wieder (Format 13/18, Distanz 1.50 m, Tubusöffnung 6 cm, Richtung des Strahles 8 zu 2). Diese

Aufnahme wurde unter Einstellung auf die bei der Durchleuchtung gemachten Hautmarken einen Tag nach der Durchleuchtung »geschossen«.



Abb. 8. Schrapnellkugel rechts subscapular. 9/12, Distanz 1.50 m, Tubusöffnung 1.75 cm, Projection 11 zu 10.

Abb. 7 a zeigt einen rechtsseitigen Ausschnitt aus einer Lungenaufnahme, die Abb. 7 b die entsprechende Seitensicht dazu in schräger Richtung, welche einen interlobären Flächenschatten im kleinen Lappenspalt deutlich zur Darstellung bringt (Format 13/18, Distanz 2 m, Tubusöffnung 2 cm, Richtung 6 zu 8). Abb. 8 zeigt eine Schrapnellkugel in den Weichteilen der rechten Schulter zwischen der Aussenfläche der Rippen und der Innenfläche des Schulterblattes (Format 9/12, Distanz 1.50 m, Tubusöffnung 1.75 cm, Richtung des Strahles 11 zu 10). — Andere Beispiele typischer und atypischer Aufnahmen geben wir in einer Mitteilung in der »Röntgenpraxis« Jahrg. 5.

Beispiele von Fernaufnahmen bei waagrechtem Strahlengang und geneigter Kassette (Einfallswinkel von + bis - 90°).

Manche Aufnahmen erfordern eine Neigung der Röhre von oder zur Kassette, oder anders gesagt, bei unverändert senkrechter Stellung der

Röhre eine Neigung der Kassette aus der Senkrechten von oder zur Röhre. Im engeren Sinne sind hier Neigungen gemeint, bei denen die Ebene der Kassette von einer durch die senkrecht stehende Röhre gelegten Sagittalebene im rechten Winkel durchtreten wird. Eine einfache Zusatzvorrichtung am Kassettenrahmen (siehe die folgenden Abbildungen) gestattet die Kassette um die Senkrechte in ihrer Lage um mehr als 100° zu verändern.

Einstellung einer occipito-mental *Aufnahme der Nasennebenhöhlen*: Distanz 1.50 m, Format 13/18 oder 18/24, Kassette geneigt 45° von der

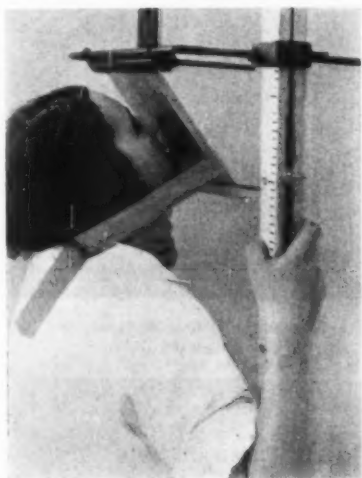


Abb. 9. Einstellung einer occipito-mental Aufnahme der Nasennebenhöhlen. Kassette geneigt 45° von der Verticalen zur Röhre.



Abb. 10. Einstellung einer Unterkieferaufnahme. Kassette geneigt 20° von der Verticalen weg von der Röhre.

Senkrechten zur Röhre hin. Der rückwärtsgeneigte Kopf liegt mit Nase und Kinn der Platte auf, festgehalten durch einen Gurt (Abb. 9). Einstellung wie oben: Bestimmung der Höhe der Kassettenmitte, Zielen auf diese, Parallelverschieben der Röhre. Einstellung einer *Aufnahme des Unterkiefers*: Distanz 2 m, Tubusöffnung 1.25 cm, Format 9/12. Kassette geneigt 20° von der Senkrechten weg von der Röhre (Abb. 10). Pat. sitzt, den Unterkiefer der Kassette anliegend, das Hinterhaupt mit einem schmalen Sandsack gestützt. Einstellung wie oben: Bestimmung der Höhe der Kassettenmitte, Zielen auf diese, Parallelverschieben der Röhre.

Mit der Erwähnung dieser Beispiele von typischen und atypischen Aufnahmen ist das Gebiet der Einstellungsmöglichkeiten auch für den

waagrechten Zentralstrahl nicht ausgeschöpft. Aus Gründen einfacher Darlegung der Methode wurden nicht angeführt Aufnahmen im waagrechten Zentralstrahl bei Einfallswinkeln, welche von der Sagittalebene abweichen, ferner wurden nicht angeführt solche in schrägen Zentralstrahlen.

Bei prinzipieller Betrachtung dieser berichteten Art der Einstellung zu Röntgenaufnahmen ergibt sich, dass sich diese Einstellungsart ebenso zur Nahaufnahme wie zur Fernaufnahme eignet. Doch zeigen sich besonders bei der letzteren ihre Vorzüge. Als vorteilhaft fanden wir bei einem einjährigen Gebrauch der Methode

1. die Leichtigkeit und Genauigkeit der Einstellung
2. die Reproduzierbarkeit der Einstellung bei späteren Aufnahmen, wenn man Eintritts- und Austrittspunkt des Zentralstrahles durch Maße oder Zeichen vermerkte
3. die Möglichkeit der Verwendung des jeweils kleinsten Filmformates
4. die Verwendung eines kurzen, leichten Tubus mit enger Öffnung, dadurch erfolgte Herabsetzung der Raum- und Streustrahlung, deren Folgen zunehmende Bildschärfe und erhöhter Strahlenschutz für Untersucher und Untersuchten sind.
5. zeitliche und räumliche Loslösung der gezielten Fernaufnahme von der Durchleuchtung.

ZUSAMMENFASSUNG

Die Mitteilung beschreibt eine Einstellvorrichtung für gezielte typische und atypische Fernaufnahmen. Das Gerät besteht aus einer an jeder Röhre und Universalstativ montierbaren Platte mit querabgehenden Seitenflächen, auf deren einer zur Kontrolle der Lage Wasserwaagen angebracht sind. Die andere Fläche dient als Unterlage für eine drehbare und fixierbare Tragplatte für Klemmen, in welcher letztere ein optischer Sucher eingeschoben wird. Die Einstellvorrichtung gestattet eine zuverlässige Parallelstellung des Zentralstrahles des Suchers zum Zentralstrahl der Röntgenröhre. Nach Anvisieren des zu röntgenographierenden Objectes kann (für jede Entfernung Röhre-Schicht gleichbleibend) durch Parallelverschiebung der Röhre um den Abstand beider Zentralstrahlen eine genau eingestellte Röntgenaufnahme gemacht werden. Es wird berichtet über die Einstellung des Gerätes und über einige Aufnahmearten, die mit dieser Einstellungsart vorgenommen wurden.

SUMMARY

The author describes a focussing device for distant roentgenography under typical and atypical conditions, which can be mounted on any tube or universal stand. It consists in a disc with perpendicularly rising sides, on one of which is placed a water level to control its position, while the other serves as support for a turnable and fixable plate fitted with clutches, into which can be introduced an optical finder. By this device, the central ray of the finder can be brought into a

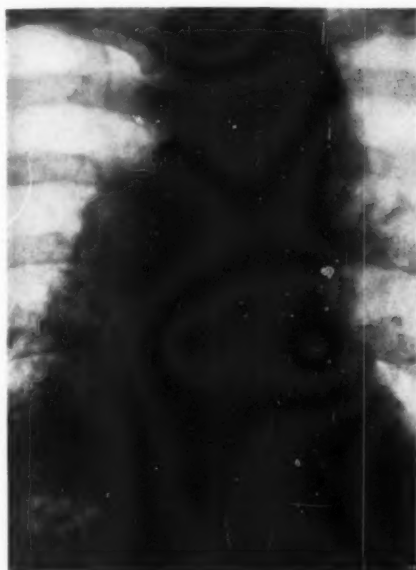


Abb. 6 a: Ausschnitt aus einer p.-a. Lungenaufnahme.

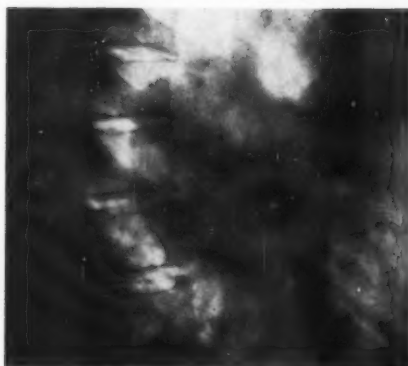


Abb. 6 b: Tumor am rechten Hilus. Projection 8 zu 2. 13/18, Distanz 1.50 m, Tubusöffnung 6 cm.



Abb. 7 a: Ausschnitt aus einer p.-a. Lungenaufnahme.

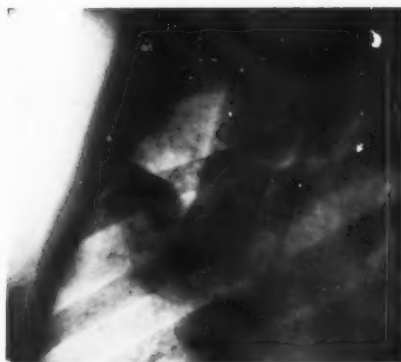


Abb. 7 b: Flächenschatten im kleinen Interlobium. 13/18, Distanz 2 m, Tubusöffnung 2 cm, Projection 6 zu 8.



position exactly parallel to that of the central ray of the roentgen tube. After the object to be roentgenographed has been brought into sight, an exactly focussed picture can be made by moving the tube over for the distance of both the central rays, the level of the tube remaining the same regardless of the distance. The author gives directions for the adjustment of the apparatus, and describes the manner in which it was used under a number of various conditions.

RÉSUMÉ

La communication décrit un dispositif de mise au point pour les radiographies à distance typiques et atypiques. Ce dispositif comprend une plaque pouvant être montée sur chaque tube de pied universel, avec faces latérales transversales, sur l'une desquelles se trouve fixé un niveau d'eau, en vue de contrôler la position. L'autre face sert de support à une plaque porteuse pour pinces, sur laquelle se trouve un viseur optique. Ce dispositif de mise au point permet d'orienter d'une façon certaine le rayon central du viseur parallèlement au rayon central de l'ampoule. En visant l'objet à radiographier, on peut ainsi (pour une distance constante ampoule-couche), par déplacement parallèle de l'ampoule à la distance des deux rayons centraux prendre une radiographie rigoureusement mise au point. L'auteur communique le mode d'installation du dispositif et donne quelques modalités de radiographies réalisées à l'aide de cette mise au point.

